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TRANSACTIONS

of the

American Ophthalmological Society

VOLUME XIII

1912–1914

Philadelphia
American Ophthalmological Society
1915

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Forty-Eighth Annual Meeting

ATLANTIC CITY, N. J., 1912

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1912

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Dr. Oliver Fairfield Wadsworth.

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NECROLOGY.

DR. OLIVER FAIRFIELD WADSWORTH.

MYLES STANDISH, M.D.,
Boston.

Dr. Oliver Fairfield Wadsworth, son of Alexander and Mary Elizabeth Hubbard (Fairfield) Wadsworth, was born in Boston, April 26, 1838. He was a descendant of Christopher W. Wadsworth, who came to Boston in 1632. He attended the Latin School, entered Harvard College in 1856, and was duly graduated with the A.B. degree in 1860. In 1863 he received the degree of A.M.

Upon graduation he took up the study of medicine in the Harvard Medical School, where it was early noted that he was a man of exceptional quality.

He was appointed House Pupil, as the house officers were then designated, at the Massachusetts General Hospital, and served the usual term. The degree of M.D. was conferred upon him in 1865.

In April, 1865, he was appointed assistant surgeon to the Fifth Massachusetts Cavalry, and served with that regiment in the Southwest, being stationed most of the time in Texas. When the volunteer army of the Civil War was disbanded, Dr. Wadsworth proceeded to Zurich, Switzerland, for postgraduate study in ophthalmology. He worked under Professor Hörner, and made some most excellent original investigations.

Upon his return to Boston he married, April 16, 1867, Miss Mary Chapman Goodwin of that city.

He was appointed ophthalmic surgeon in the out-patient service of the Massachusetts General Hospital in 1873, and served in the various grades at that institution until 1900, when he was made a member of the Board of Consultation.

He was appointed ophthalmic surgeon in the out-patient service of the Boston City Hospital in 1870, ophthalmic surgeon in 1881, and subsequently was appointed ophthalmic surgeon-in-chief, which position he held until his death, although he did little actual service in his later years.

In 1892 he was appointed ophthalmic surgeon at the Massachusetts Charitable Eye and Ear Infirmary without any previous service in the junior positions at that institution. This appointment was made by the Board of Managers at the Infirmary with the consent and approbation, expressed and unexpressed, of the entire junior ophthalmic staff, although such an appointment delayed the line of promotion —a striking tribute to his professional eminence and the profound esteem in which he was held by the younger ophthalmologists of Boston.

Dr. Wadsworth was appointed instructor in ophthalmoscopy in the Harvard Medical School in 1881, and continued to give instruction under that title, but not always in ophthalmoscopic subjects, until 1891, when he was appointed Professor of Ophthalmology, and given the title of Williams Professor of Ophthalmology in 1898, an endowed professorship established by his distinguished predecessor in the chair of ophthalmology in the Harvard Medical School, Dr. Henry W. Williams. Dr. Wadsworth held the professorship until 1903, when he gave up all his active hospital and teaching services.

At the head of the department of the Medical School, he was conservative, but always open to conviction in favor of any change in the management or teaching of the department which was brought forward by his juniors.

Under his administration required clinical as well as written examinations were introduced in ophthalmology, the clinical examination mark counting for 40 per cent of the total credits in the department. The department of Ophthalmology was the first in the Harvard Medical School to adopt such a system, which has since become widely established in other clinical departments.

The conscientious individual consideration which he gave to the marks awarded to the students was very unusual, kindly and just, although the students generally considered his examinations difficult to pass. Until almost the last year of his professorship he felt it his duty to teach the students who elected advanced ophthalmology, and spent hours patiently teaching the minute observation necessary for difficult ophthalmoscopic diagnosis.

Dr. Wadsworth's skill in the use of the ophthalmoscope and the accuracy of his ophthalmoscopic diagnoses were known to all his colleagues, and were universally acknowledged by all who came in contact with him professionally. The careful study and patient investigation which he gave to each case that came under his care was never abridged by any consideration of time or personal convenience. His mental attitude until his diagnosis was made was always that of the impartial scientific observer.

As an operator he was cool, confident and skilful, following the safe and well-known methods rather than new or original procedures.

His knowledge of ophthalmic literature was co-extensive with modern ophthalmology, and he was very unusual in his ability to recall the substance of all original articles on any topic, together with the names of the writers and places of publication. This quality made him a formidable antagonist in any ophthalmic discussion. Cautious in the acceptance and statement of facts, exact in thought and logical in his deductions, his conclusions were always respected and made him an authority widely acknowledged.

His many hospital and teaching positions associated nearly all the younger ophthalmologists of Boston with him at some time in his career, and his persistent and able defense of what he considered to be the truth in ophthalmic facts, his scientific accuracy of observation, and calmness of judgment left its impression upon an entire generation of ophthalmic surgeons in that city.

Dr. Wadsworth was markedly faithful to every duty he undertook, untiring in his capacity for work, kind and just to his juniors, and beloved by his contemporaries. He published forty-two original articles on ophthalmological subjects. Many of these papers have appeared in the Transactions of this Society. The Index Medicus lists fifteen of the titles of his papers under retina, choroid, and optic nerve, four upon anomalies of muscular balance, nine upon operative procedures, and four papers devoted to scientific original research. His best known original work was his description of the fovea centralis. All of his writings were, as one would expect them to be, well considered and accurate, and were written because the author had something to say which justified the recital.

He was one of the founders of the Boston Medical Library Association, and was elected Secretary at the first meeting of that organization in 1875, and continued in that office for thirty-six years. At the date of his resignation the library contained 72,000 volumes. During the last years of his term of service he was active in the efforts which made possible the beautiful new library building.

He was five years president of the American Ophthalmological Society, president of the New England Ophthalmological Society, was honored by election as an Associate Fellow of the College of Physicians of Philadelphia, and died after a cheerful and uncomplaining endurance of a painful illness on November 29, 1911, respected by all his colleagues and acquaintances.

Dr. Alvin Allace Hubbell.

DR. ALVIN ALLACE HUBBELL.

LUCIEN HOWE, M.D.,
Buffalo, N. Y.

The Transactions of our Society are useful not only for the scientific data which they contain, but also for the records of the lifework of its members. One result of our limited numbers is that we become well acquainted with each other, and, after years of labor in the same field, that acquaintance often ripens into real affection.

It is not surprising therefore that when one of our band falls in the ranks, and a colleague is asked to prepare even a short biographic sketch, the assignment is considered an honor, and is entered upon as a labor of love. At least such would be the attitude of almost any one invited to prepare a memoir of a colleague who has wrought to such good advantage, and whose record is as honorable as our former associate, Dr. Alvin Allace Hubbell, who died on the 10th of August, 1911.

The circumstances which moulded his career were not quite of the usual type. His was rather a record of success in the face of adversity. He was not born to opportunity. He made it. His parents were farmers in the little town of Conewango in western New York. As with many other prominent men, it was the little red schoolhouse which first attracted him toward the path of knowledge, a path which constantly broadened with wider and clearer views.

While still a stripling, when his mind was "wax to receive and marble to retain," he was fortunate enough to make the acquaintance of a neighboring physician, a man who exercised a potent influence in molding young Hubbell's character. This physician was another Ian Maclaren. The country lad saw in him the embodiment of scientific acquirement, with

the quiet efficiency and constant kindness which go with such a type. These qualities the boy strove to imitate. At the same time he bent his energies to obtaining a real education.

Fortunately his parents could assist him in the effort, and the academy in the town of Randolph was the first stepping-stone upward. During the intervals of work on the farm he continued at his studies. It was not quite a repetition of the experiences of Lincoln, with his book by the fireplace, but many instances show that both were animated by the same impulse.

These efforts gradually prepared the young man for entering the medical department of the University of Pennsylvania. After studying there for a time he went to the Medical School at Buffalo, where he received his degree in 1876. This did not mean to him, as to so many others, simply the permission to practise the art of medicine; to him it meant better opportunity for study and for verifying the facts about which he knew only theoretically. His first field of labor was exceedingly limited. In a little hamlet not far from where he lived he opened an office, and, although the number of patients was small, they were studied most carefully. This gave a broader foundation for work, and he soon learned that

> "One science only will one genius fit,
> So vast is art, so narrow human wit."

It was not surprising that at an early stage in his career he gave up the general practice of medicine and turned his attention to ophthalmology. Each of his eye cases served as a subject for him to study. He also realized that the stage should not be small on which to play the part for which he felt himself equipped, so he decided to move to a city. Buffalo was the place he chose. There he became active in medical societies, and already in 1880 we find him identified with the Academy of Medicine, and presenting papers on subjects relating to ophthalmology. Also, about that

time Niagara University established a medical department and in this Dr. Hubbell was made a teacher of ophthalmology and otology. He continued with the Niagara University until its Medical Department was merged with that of the University of Buffalo, and in the latter institution he was appointed to a corresponding position.

Early in his professional career he developed quite an unusual facility as a writer. He had the knack of selecting the salient points out of even a complicated question, and making it clear and easily comprehended by the average reader. This was especially evident in the numerous articles which he contributed to the Transactions of this Society and to various medical journals.

His natural mechanical turn was useful to him as an operator, and enabled him to suggest improvements in various instruments. In 1892 he published a modification of the small electro-magnet which made that instrument more effective than before, and described a number of cases in which it had served an excellent purpose.

Later he became interested in the paralyses of the ocular muscles, and contributed two interesting articles on that and other phases of the subject. For a number of years he collected the bibliography relating to the extraction of cataract, and in 1904 he presented a digest of the subject, following it up a few years later by another historical sketch.

In 1908 he was Chairman of the Section on Ophthalmology of the American Medical Association, and for his inaugural address he gave a résumé of the history of ophthalmology in America, which will remain as a record of the work in that department up to that day.

Of course, it is possible to give here only a brief outline of his professional activities, but even this is sufficient to indicate various directions to which his attention was turned. Personally he combined strength of character with the gentleness which many a practitioner well might imitate.

In early life he married Miss Evangeline Fancher, a sister of former Senator Fancher, and to them one daughter, Beulah, was born. He was always an exemplary husband, a kind father, and was identified with progressive organizations which told for the elevation of the community. He took an active part in the Unitarian church, was one of the Trustees, and also one of the trustees of a social settlement, known as Neighborhood House.

In a word, he was eminent professionally, a good citizen, a fine type of the progressive American physician, one of whom the community might well be proud, and he can truly be counted among the really prominent members of our American Ophthalmological Society.

DR. BLENCOWE E. FRYER.

R. J. CURDY, M.D.,
Kansas City, Mo.

Dr. Blencowe E. Fryer died August 12, 1911, in Sault Saint Marie, Mich., where he had gone for his summer vacation. Dr. Fryer was born in Bath, England, in 1837; his father was an officer in the British army. When seven years old, he was brought to Charleston, S. C., by his mother, then a widow, and nine years later they moved to Philadelphia.

Dr. Fryer graduated in medicine from the University of Pennsylvania in 1859, and after a term of hospital service entered the medical corps of the United States army at the beginning of the Civil War, being appointed assistant surgeon May 28, 1861. He served with distinction through the war, being promoted to the rank of captain in 1866, and of major and surgeon in 1867. In 1865 he received the brevet rank of major for conspicuous services. After the war he remained in the army medical service until his retirement in 1887.

Dr. Blencowe E. Fryer.

On retiring from active military service, Dr. Fryer located in Kansas City, and limited his practice to diseases of the eye and ear, which had long claimed his interest. He soon acquired a large practice, and also soon became deeply interested in medical teaching and in clinical work, being professor of Ophthalmology and Otology, successively, in the Kansas City Medical College, the University Medical College, the Medico-Chirurgical College, the medical department of the University of Kansas, and up to the time of his death, in the Kansas City Post-Graduate Medical College.

In connection with his medical teaching he spent much time and energy in his large clinic, which was consistently maintained during all the years of his college work, though handicapped most of this time by lack of adequate equipment and hospital facilities; and he still found time to be one of the active workers in the local medical societies. From the beginning of publication of the quarterly, "Ophthalmology," Dr. Fryer had charge of the department of French literature, and wrote the reviews of this department. His other contributions to medical literature were mostly reports of clinical cases and procedures. He was one of the early advocates of iridectomy preliminary to extraction of cataract.

A man of marked ability, of tremendous energy and capacity for work, of unfailing courtesy and kindness in his relations with others, he filled a conspicuous place in social and professional life, and afforded an example of quiet dignity and self-control which became a strong influence on the members of the local medical societies in which he was so active and so interested.

Dr. Fryer became a member of the American Ophthalmological Society in 1883, and until the last few years participated actively in its proceedings.

His illness was short; his work in practice, in writing, and in his clinic continued to within a short time of his death.

MINUTES OF THE PROCEEDINGS.

FORTY-EIGHTH ANNUAL MEETING.

THE CHELSEA,

Atlantic City, N. J., June 12, 1912.

The Forty-eighth Annual Meeting of the Society was called to order at 10 A. M. by President Dr. Edward Jackson.

The following committees were announced:

On Membership for Next Year—DRS. G. E. DE SCHWEINITZ, PETER A. CALLAN, HIRAM WOODS, W. H. WILMER, and RICHARD A. REEVE.

On Bulletin—DRS. G. E. DE SCHWEINITZ, W. T. SHOEMAKER, and WILLIAM M. SWEET.

Auditing Committee—DR. DAVID HARROWER.

Publication Committee—DRS. WM. ZENTMAYER, W. E. LAMBERT, and WILLIAM M. SWEET.

On Time and Place of Meeting—DRS. WM. H. CARMALT, SAMUEL THEOBALD, and PERCY FRIDENBERG.

On Wood Alcohol Blindness—DRS. E. GRUENING, G. E. DE SCHWEINITZ, W. H. WILDER, and WM. H. WILMER.

The following papers were read and discussed:

1. "Some suggestions to those upon whose aid the success of the ophthalmic surgeon, in considerable measure, depends," Dr. Samuel Theobald.

Discussed by Drs. Gruening, Lambert, Risley, Wescott, Reeve, and Theobald.

2. "Microscopic findings in the eyeball of a man who died from an untoward cause seven weeks after extraction of a senile cataract," Dr. W. Gordon M. Byers.

3. "Management of the capsule in cataract extraction and afterward," Dr. Edward Jackson.

4. "The relative value of recent improvement of cataract extraction," Dr. Robert Sattler.

Discussed by Drs. Ziegler, Beard, Byers, Fridenberg, Randolph, Lambert, Risley, Reeve, Callan, Theobald, Jackson, and Sattler.

5. "The operation of combined iridectomy and sclerectomy for chronic glaucoma," Dr. E. Gruening.

Discussed by Drs. Sattler, Reeve, Holt, Ziegler, and Lambert.

The President announced that the following were invited to sit with the Society and take part in its discussions: Drs. Nelson M. Black, Charles R. Heed, M. Buchanan, Thomas Gallagher, Lee Masten Francis, J. F. Crouch, David H. Coover, A. L. Macleish.

AFTERNOON SESSION.

Dr. C. H. Beard exhibited an instrument, devised by him, to prevent the accident of the excised disc dropping into the anterior chamber in the Elliott operation.

The reading of papers was resumed.

6. "A piece of glass in the crystalline lens, with description of the eye three years and a half after the accident," Dr. J. Herbert Claiborne.

Discussed by Drs. Theobald, Ziegler, Lambert, Sweet, Beard, and Claiborne.

7. "Report of six cases of degeneration of the cornea in the same family (nodular keratitis)," Dr. Dunbar Roy.

Discussed by Drs. Weeks and Roy.

8. "Idiopathic hematoma of the orbit," Dr. E. Gruening. Read by title.

9. "Calcareous degeneration of the cornea and lens capsule," Dr. Frederick Tooke.

10. "Fracture of the skull with hemorrhage into the optic

nerve-sheaths and retinas: microscopic examination of the eyeballs," Drs. G. E. de Schweinitz and T. B. Holloway.

Discussed by Dr. Hansell.

11. "Polypoidal formation in the lacrimal sac," Dr. Frederick Tooke.

12. "A case of acute suppurative dacryoadenitis," Dr. W. Gordon M. Byers.

13. "A case of bitemporal hemianopsia with acromegaly and other symptoms apparently due to disease in the pituitary region. Diagnosis confirmed by autopsy," Dr. S. D. Risley.

Discussed by Drs. Hansell, Rogers, Weeks, Jackson, Holloway, Zentmayer, Parker, Bruner, and Risley.

14. "Amblyopia from inhalation of methyl alcohol," Dr. Henry H. Tyson.

Discussed by Drs. Curdy, Callan, Ziegler, Sattler, and Tyson.

15. "Hereditary optic atrophy with *x*-ray findings," Dr. William Evans Bruner.

Discussed by Drs. Bedell and Randall.

EXECUTIVE SESSION.

The President, Dr. Edward Jackson, called the meeting to order at 5 P. M.

The Treasurer's report was read, and, the Auditing Committee having certified to its correctness, it was accepted and placed on file.

It was voted that the assessment for the current year be five dollars.

The Committee on Membership recommended that the word oculist or any similar title should not appear after the names of members of the American Ophthalmological Society in the city or telephone directories. Carelessness in that respect frequently caused the Committee great embarrassment when considering candidates for membership in the

Society. There had been some names presented to the Committee this year who were, in the estimation of the Membership Committee, deemed worthy to be members of the Society, but after whose names in the city directories where they lived appeared the words oculist, ear, nose, and throat. While the Committee was advised that the insertion of the words was without the knowledge of the candidate, nevertheless it was a serious matter, not only to the candidate but to members who proposed the name, since the attachment to the name of any member in any public manner of a title announcing that he gave exclusive attention to special practice was contrary to the Constitution of the Society.

The Committee on Membership recommended the following-named candidates for admission to the Society, and they were declared elected as Associate Members:

Dr. Oscar Dodd, Chicago, Ill.
Dr. E. Terry Smith, Hartford, Conn.
Dr. Edward R. Williams, Boston, Mass.
Dr. Albert C. Sautter, Philadelphia.
Dr. H. Maxwell Langdon, Philadelphia.
Dr. George S. Crampton, Philadelphia.
Dr. E. C. Ellett, Memphis, Tenn.
Dr. Edmund W. Clap, Boston, Mass.
Dr. E. Török, New York City.
Dr. P. Chalmers Jameson, Brooklyn, N. Y.
Dr. Willard G. Reynolds, Brooklyn, N. Y.

The Committee also referred the names of other candidates to the Committee for 1913.

The Committee presented the following nominations of officers of the Society for the ensuing year:

President: Dr. Myles Standish, Boston, Mass.

Vice-President: Dr. Robert Sattler, Cincinnati, Ohio.

Secretary and Treasurer: Dr. William M. Sweet, Philadelphia.

Corresponding Secretary: Dr. Arnold Knapp, New York.

It was moved that the Secretary be authorized to cast a ballot for the election of the officers as nominated by the Committee, which motion was carried, and the officers were declared elected.

The Committee on Bulletin reported, through the Secretary, that considerable difficulty had been experienced in preparing the program for the meeting, owing to the delay on the part of members in sending the titles of papers to be read. The standing rule adopted by the Society in 1909 provided that the request for titles be made two months prior to the meeting, that the call for the meeting be sent out one month later, and that no paper be eligible for presentation at the meeting unless the title and an abstract of the paper be printed in the call.

The Chair remarked, in reference to the difficulty, that in former years the Society did not require titles of papers to be presented at any fixed time before the meeting, and it was the custom for the members to bring the titles to the meeting, and the Bulletin Committee arranged the papers on the first day of the meeting. It was probable that some of the members had grown accustomed to this plan and had therefore neglected to send titles in time. If this Society is to compete with other societies in completeness and attractiveness of meetings, it is necessary for the members to send in the titles of their papers, with the abstracts, so that they may be published previous to the meeting. It was an important point bearing on the success of future meetings of the Society, and would be doubly important next year when the program had to be printed in connection with the program of the Congress of American Physicians and Surgeons at Washington.

The Committee on Time and Place of Meeting had no report to make, as the next meeting of the Society would be held in Washington, D. C., May 6 and 7, 1913, in connection with the Congress of American Physicians and Surgeons.

The Secretary stated that no report had been received from the Committee on Ophthalmia Neonatorum. The President said that he believed no meeting had been held or action taken in the past year. It was moved and carried that the Committee be discharged, with thanks.

Dr. Wilmer, on behalf of the Committee on Wood Alcohol Blindness, stated that the Committee had kept in touch with Dr. Wiley as long as he existed in his official capacity, and that it had frequently received reports from many State officers showing that prosecutions had been successful against violations of the interstate laws. A great deal of good had been accomplished in that way by the Interstate Board. The report was received and the Committee continued.

The Secretary read the following list of deaths of members of the Society during the past year:

Dr. O. F. Wadsworth, Boston, Mass.

Dr. A. A. Hubbell, Buffalo, N. Y.

Dr. B. E. Fryer, Kansas City, Mo.

Dr. H. L. Shaw, Boston, Mass.

Dr. J. P. Davidson, Richmond, Va.

The President appointed the following Committee to prepare the obituaries for publication in the Transactions: Drs. Myles Standish, Lucien Howe, and R. J. Curdy.

The President appointed Dr. W. H. Wilmer, of Washington, as a member of the Committee of Arrangements for the Congress of American Physicians and Surgeons.

MORNING SESSION, JUNE 13.

Dr. David Harrower exhibited a pocket-lamp, with a little battery fitted with a Tungsten light.

The reading of papers was resumed.

16. "A case of transient blindness, complete in one eye, partial in the other, with double optic neuritis," Dr. Howard F. Hansell.

Discussed by Drs. May, Reeve, Woods, Risley, and Hansell.

17. "Flat sarcoma of the choroid," Dr. Cassius D. Wescott.

Discussed by Dr. Weeks.

18. "Sarcoma of the eye. Report of three cases," Dr. S. C. Maxson.

Discussed by Drs. Reeve and Weeks.

19. "A case of primary intradural tumor of the optic nerve," Dr. William M. Sweet.

Discussed by Dr. Hansell.

20. "A case of plexiform neurofibroma involving the orbit," Dr. Wm. Zentmayer.

Discussed by Drs. Beard and Zentmayer.

21. "A case of endothelial sarcoma of the orbit," Dr. John E. Weeks.

Discussed by Drs. Roy and Weeks.

22. "A case of chloroma," Dr. Robert Sattler.

Discussed by Drs. Bedell, Sattler, and Roy.

23. "The treatment of trachoma with radium. The use of radium-coated celluloid plates for this purpose," Dr. Charles H. May.

Discussed by Dr. Reeve.

24. "Recurrent retinal hemorrhages occurring in the young, with the report of a case," Dr. A. Edward Davis.

Discussed by Drs. Foster, Sattler, Wilmer, Weeks, Ziegler, Woods, Risley, and Davis.

EXECUTIVE SESSION.

The President, Dr. Edward Jackson, called the meeting to order at 12:30 P. M.

The Secretary read a communication from the Secretary of the Congress of Hygiene and Demography, calling attention of the Society to the meeting to be held in Washington from September 23 to 28, 1912. It was moved and carried that the President and Secretary for the ensuing year be authorized to issue credentials to any members of the Ameri-

can Ophthalmological Society who wished to attend the Congress.

Adjourned.

Members present at the Forty-eighth Annual Meeting:

Adams, A. E.
Adams, John L.
Beard, Chas. H.
Bedell, Arthur J.
Bordley, James, Jr.
Bruner, Wm. Evans
Butler, W. K.
Byers, W. G. M.
Callan, Peter A.
Carroll, James J.
Chance, Burton
Claiborne, J. H.
Culver, C. M.
Curdy, Robert J.
Cutler, Colman W.
Davis, A. E.
Duncan, J. L.
Fenton, Thomas H.
Foster, M. L.
Fox, William H.
Fridenberg, Percy
Friedenwald, Harry
Gould, George M.
Greene, Louis S.
Gruening, E.
Hansell, Howard F.
Harlan, Herbert
Harrower, David
Haskell, H. H.
Holloway, T. B.
Holt, E. E.
Jackson, Edward
Kilburn, Henry W.
Lambert, Walter E.
Lancaster, Walter B.
Lovell, D. B.
Maxson, S. C.
May, Charles H.
Parker, Walter R.
Post, M. H.
Price, H. R.
Pyle, Walter L.
Radcliffe, McCluney
Randall, B. Alex.
Randolph, Robert L.
Reese, Robert G.
Reeve, R. A.
Ring, G. Oram
Risley, J. Norman
Risley, Samuel D.
Rogers, William K.
Roy, Dunbar
Sattler, Robert
Schneideman, T. B.
Schwenk, Peter N. K.
Shoemaker, J. F.
Shoemaker, Wm. T.
Shumway, Edw. A.
Snell, Albert C.
Stieren, Edward
Sweet, Wm. M.
Theobald, Samuel
Tooke, Fred.
Tyson, Henry H.
Webster, David
Weeks, John E.
Wescott, Cassius D.
White, J. A.
Williams, Carl
Wilmer, W. H.
Woods, Hiram
Zentmayer, W.
Ziegler, S. Lewis

SOME SUGGESTIONS TO THOSE UPON WHOSE AID THE SUCCESS OF THE OPHTHALMIC SURGEON, IN CONSIDERABLE MEASURE, DEPENDS.

SAMUEL THEOBALD, M.D.,
Baltimore.

However skilful the ophthalmic surgeon may be, the results of his work are materially influenced by the efficiency or lack of efficiency of those upon whose aid he must, in no inconsiderable measure, depend. An awkward surgical assistant, a nurse ill-trained or without aptitude, may, with the best intentions, perhaps, bring to naught his most painstaking efforts, and convert an operative procedure which otherwise would have been a success into a partial or complete failure. Every oculist who has operated extensively doubtless can recall such an experience. It has seemed to me, then, well worth while to offer some practical suggestions to those whose duty it is to supplement the work of the ophthalmologist.

The Surgical Assistant.—As of greatest importance may be considered, first, the services of the surgical assistant. In many minor operations lack of skill or experience upon his part may be an inconvenience only; in other more important and delicate ones the success or failure of the operation may hinge upon it.

The assistant's first duty, it may be said, is to learn, as for example in "fixing" the eye, to keep his hands out of the operator's way. This is always practicable, and with a little study the art can easily be acquired. A steady hand on his part is also essential, and, if he will observe his chief, he will find that this is attained by resting the wrist or some

part of the hand, the ring or little finger most probably, upon the patient's cheek or forehead. Few, if any, ophthalmic surgeons operate "from the shoulder." Again, if his fixation is to be satisfactory, he must grasp the conjunctiva, and a fairly broad grasp it should be, close to the corneal limbus, otherwise the loose conjunctiva will stretch, and the eye will not be held securely. If he is asked to rotate the eye in a certain direction, he must not simply *pull* it in this direction, but, bearing in mind the ball-and-socket-like movements of the eye resulting from the conjoint action of the straight and oblique muscles, he must really *rotate* it in the direction indicated; and in all such maneuvers, of course, he should be careful to exert a minimum amount of pressure upon the eyeball.

The sponging of an eye during a delicate operation, such as cataract extraction, deserves almost to be ranked as an art. For myself, I do not like dry sponging, but prefer the sponge should be dipped in a sterile boric solution, and then squeezed nearly dry, before it is used.

I also make it a rule, and I regard it as of real importance, that in such operations the assistant shall not sponge the eye unless he is directed to do so, and he is further cautioned to avoid, as far as may be practicable, bringing the sponge in contact with the cornea.

There is a certain maneuver, hard to describe and, it would seem, not easily learned by the average assistant,—perhaps, one might describe it as a momentary pressure followed by a gentle wipe,—that is most effectual in removing coagulated blood from the conjunctival sac. It is often very helpful to the operator, and he is fortunate in having an assistant who has acquired the knack.

The elevation of the upper lid, in addition to that afforded by the speculum, in some cases facilitates the work of the surgeon. The assistant should do this with the forefinger, being careful to avoid pressing upon the eyeball. Another

most helpful service that he will occasionally be called upon to perform is to exert counterpressure upon the scleral margin of the section to facilitate the extrusion of an obdurate cataract—one, perhaps, with an exceptionally large nucleus. In doing this he should gently depress the upper edge of the wound with a Daviel's curet, so as to cause the section to gape slightly, being careful that the instrument does not obstruct the exit of the lens; and when the lens is well engaged in the section, if called upon to do so, he may help to deliver it with the curet by lifting or rotating its margin through the wound.

The assistant who can do all the things I have enumerated just as the operator would have them done, if, perhaps, not worth quite his weight in gold, as the phrase runs, is, at all events, worth more than a score of helpers who can do them only in tolerable fashion.

The Nurse.—One of the most helpful advances in modern medicine and surgery, as all will agree, has been the providing of the trained nurse; but, until she has had very special training, she is not as helpful to the ophthalmologist as could be wished. For example, she has little appreciation of the delicacy of his instruments. She cannot understand, as I have learned to my sorrow, why a cataract or an iridectomy knife should not be put loose in the tray of an instrument case intended for forceps, needle-holder, and artery clamps, or why his cutting instruments should not be boiled as long as his speculum or strabismus hook, or why they should not be boiled after, as well as before, an operation. A sponge is a sponge to her, and she fails to comprehend why the eye-surgeon makes such a pother about its size. In using an eye-dropper, she commonly holds it upside down, and she is as apt to place the candle for oblique illumination behind the patient's head as she is to hold it in front of it for an ophthalmoscopic examination.

She speaks of a fifty per cent. solution of boric acid

when she means a saturated solution which has been reduced to half this strength, about two per cent., by the addition of water; and, if the operator is so indiscreet as to permit her to wash and dry his cutting instruments, he, not improbably, will later realize his indiscretion. She offers to flood the room with sunlight for a first inspection after a cataract extraction, and wonders why he should prefer the dim light of a single candle, which she finally procures for him after much diligent searching.

However, if she is reasonably intelligent and observing, and has had the advantages of a well-conducted training school, it will not require many weeks in an ophthalmic hospital to eliminate these particular shortcomings, and, assuming she is interested in the work, she will presently be as dependable and as helpful to the surgeon in her new field of labor as she was in the routine of the general hospital.

She will soon learn that the keen edge of a cataract knife will not stand more than thirty seconds' boiling, and that the slightest rough usage will blunt its delicate point; that the gauze needed to make a single sponge for the general surgeon suffices to make half a dozen or more for the ophthalmic surgeon; that the solution in an eye-dropper is apt to be contaminated if the dropper is held with its tip uppermost; that a candle-flame in a moderately darkened room, with the help of a convex lens, affords a far more satisfactory view of the eye than any amount of diffuse daylight, and that the proper place to hold the candle for such an examination is a little in front of and fifteen or twenty inches distant from the eye to be inspected.

She will also learn, or should learn, that the important point with reference to the illumination of a ward or room in an ophthalmic hospital is that it should be *constant*, that, for example, a window-shade should not be allowed to be blown back and forth by the wind, so that at one moment sunlight floods the room, and at the next moment it is com-

paratively dark; that a painful eye is often made less so by elevation of the patient's head with an extra pillow or two; that, especially after a delicate operation, a patient with both eyes closed should never be permitted to take a single step without guidance; that the easiest way to drop a solution into an eye, and the way least perturbing to a nervous patient, is to draw the lower lid slightly away from the eye, while the patient throws his head back and looks upward, and let the drop fall into the space between the lower lid and the eye; that, if it is important the solution should come, undiluted, in contact with the cornea, the upper lid should be drawn up and away from the eye, while the patient, with his head thrown back, looks downward, the cornea being thus exposed, so that the drop may be made to fall directly upon it; that in employing poisonous collyria, as, for example, a strong solution of atropin or hyoscyamin, it is best to instil into the eye one or, at most, two drops, while with non-toxic solutions it usually does no harm, though it is wasteful, to apply more than two or three drops; that an eye-dropper, if it is to be used for more than one patient, should not be contaminated by permitting its point to come in contact with the lid margin or eyelashes, and that a dropper with which atropin or other mydriatic has been instilled should not be used presently to apply, for example, a zinc or boric acid solution to the eye of another patient, if one would avoid causing the second patient several days of unnecessary inconvenience from mydriasis. And, finally, if she is exceptionally clever and painstaking, the neophyte may, some day, succeed in making with absorbent cotton and a wooden toothpick a mop which, without reconstructing it and, further, without doing violence to his conscience, the surgeon can use.

One of the most responsible duties falling to the lot of a nurse in an ophthalmic hospital is the cleaning and sterilization of an eye preparatory to an important operation. In

doing this she should be, in the first place, most careful that the antiseptic solution employed is of the prescribed strength; for, if it is too strong, marked conjunctival injection, if not actual inflammation, may be induced, necessitating, possibly, as has happened in my experience, a postponement of the operation; while, on the other hand, if it is too weak, the sterilization may be ineffectual. In the next place, while she should be thorough in washing the lids and in flushing the eye with the antiseptic, she should, at the same time, be gentle in her manipulations, bearing in mind that the eye is an organ that resents rough usage. This admonition, it may be observed, applies with equal force to her care of an inflammation of the eye attended by copious discharge, in which frequent cleansing is called for, as in gonorrheal conjunctivitis. Here it is of the greatest importance that, in removing the discharge, she should be most careful not to abrade the corneal epithelium, since such a seemingly trivial traumatism may be the starting-point of a destructive secondary infection of the cornea. And, in this connection, it may be further suggested to the neophytic ophthalmic nurse, and, perhaps, to some who hardly deserve to be so classified, that in the management of infectious diseases of the eye a thorough washing of the hands with soap and water, after contamination, is a much safer and more effectual measure than simply dipping them for a moment, as I have seen practised, in a bichlorid solution.

The Apothecary.—A few suggestions to the apothecary, which I should be glad to feel might be heeded, seem to be called for.

First, I would entreat him never to dispense a so-called "safety" eye-dropper, the kind that has a flange-like affair near the tip, since it is an unmitigated nuisance, and distinctly less safe than the ordinary dropper.

Secondly, I would suggest to him never to furnish, with a collyrium, a straight-pointed eye-dropper, nor one that

has a sharply curved tip. The dropper that is most useful is one that is not too long and has a slightly bent and not too slender tip. It will, if necessary, draw the last drop of the solution from the vial, which the straight one will not do, and it is less likely to catch in the neck of the vial and be broken than is the one that is sharply curved.

Thirdly, I would ask him to dispense the ophthalmologist's much-prescribed yellow oxid of mercury ointment not in an opal glass box, now so much in favor, but in an amber-colored one, since this prevents the chemical action of light upon the mercury salt, and preserves the ointment much longer.

Finally, I would beg him, and this I do with many misgivings, knowing how difficult it is to uproot an old prejudice, to lay aside the mortar and pestle in preparing solutions of readily soluble drugs, such as sulphate of atropin, and, instead, simply put the ingredients in a clean vial, insert an equally clean cork, give the vial a shake, and be satisfied. If he knew, as I do, how much more apt the mortar and pestle solution is to develop a fungous growth, after standing a week or two, than the one prepared in the simple manner suggested, he would, perhaps, be "almost persuaded."

It has been a matter of no little astonishment to me to learn recently, from one of the most reliable apothecaries in Baltimore and also from the dean of the College of Pharmacy connected with the University of Maryland, that they still uphold and teach the propriety of using the mortar and pestle in the manner indicated, without reference to the solubility of the drug prescribed. Certainly, in these days of asepsis and antisepsis, and of warring against contamination, the practice seems distinctly anachronistic.

To the *surgical instrument maker* I would say: When one's favorite cataract or iridectomy knife is sent to be sharpened, pray use only an oil-stone, if possible. Do not *grind* it, if it can be avoided, for, when the "favorite" comes

home, after the grinding process, its owner too often can hardly look upon it without recalling, sadly, Byron's lines:

"Shrine of the mighty! Can it be
That this is all remains of thee?"

I would also call his attention to a reprehensible tendency, which in recent years seems to have possessed his craft, to make the shanks of such instruments as canaliculus knives, strabismus hooks, and cataract needles inordinately long, and to another equally reprehensible tendency to give too sharp a curve to the blades of iridectomy scissors and of iris forceps; and I would further suggest that an iridectomy knife is more complètely under the control of the operator, and can be used with more deftness, if the angle between the shank and the blade is very obtuse, considerably more so than is usually the case with those made at the present day.

The *manufacturing optician* I would entreat never again to furnish cylindrical glasses, with *opaque sides*, in an oculist's trial-case. There is no possible advantage in making the cylinders in this fashion, and there are two decided disadvantages. In testing cylindro-prismatic glasses which one has prescribed it not infrequently happens that the opaque portion of the cylinder must be placed just where it obstructs one's view, and so prevents an accurate determination of the strength of the prism. Again, if the cylinder, especially with its axis approximately horizontal, happens not to be carefully centered in the trial-frame, there will be complaint from the patient that something, probably the upper opaque portion of the lens, is obstructing *his* view.

The American Optical Company, and probably other manufacturing concerns, make cylinders with the axis marked by two small, circular, white discs placed about 2 mm. from the edge of the lens, and with a line, more exactly indicating the axis, running from each disc to the metal rim. I have found these most satisfactory, and, it seems to me, they can hardly be improved upon.

The only other suggestion I have to offer is to emphasize the great importance of accurately centering trial-case lenses. This is not always done with the exactness that it might be, and the consequence is that errors are liable to occur in one's estimate of ocular muscle faults, and confusion and contradictory results in neutralizing compound prescription glasses in which there is a prismatic element.

DISCUSSION.

Dr. EMIL GRUENING, New York: I miss one important factor. We do but rarely fail because of the inefficiency of the assistant or nurse, but we frequently do because of the lack of control of the patient. The ophthalmic patient must be trained. In recent years I operated upon a large number of cases with general anesthesia in order to eliminate the resistance of the patient. The vomiting after the anesthetic has not caused in my cases an opening of the wound or a loss of vitreous. If we do not wish to use a general anesthetic, we may inject morphin, subcutaneously, or cocain, subconjunctivally, to have our patient well in hand. Whatever happens, happens in most cases because the patient is uncontrollable.

Dr. W. E. LAMBERT, New York: The paper of Dr. Theobald is interesting from a number of points. The one that strikes me as most important is that touching upon the lack of proper training of nurses, not only in assisting in operation, but in the care of our patients. It is most difficult in these days to get a graduate nurse with a knowledge of the care of the eye, and the training schools for nurses are ignoring the importance of teaching their pupils anything about eye nursing, just as the medical colleges are disregarding the importance of training their students to know something of the eye. I think we ought to make an effort to impress upon the training schools the importance of giving their nurses an opportunity for training in that specialty just as they are compelled to attend the lying-in hospital. They should be compelled, before they are given their certificates, to attend for at least a short time in one of the various ophthalmic and aural institutions.

DR. SAMUEL D. RISLEY, Philadelphia: I wish to say that

Dr. Theobald's paper throughout illustrates the fact that he has had large experience in the matter of which he has written. Dr. Theobald mentioned in his paper, I think in too cursory a manner, the necessity for economy upon the part of assistant surgeons and nurses in our hospitals. I have often been annoyed by their improvidence, when I knew of the very slender bank balance, to see one of the resident surgeons pick up a quarter of a pound of absorbent cotton when a piece the size of a walnut would have done just as well. We all know from our private office expense account how very costly good absorbent cotton is. Bandages are wasted to a great extent in our hospitals by careless and extravagant use. Another thing which, if Dr. Theobald mentioned, I failed to catch: the necessity for careful selection of smoked protecting glasses. The majority of them found in the market, especially the so-called mussel-shell or coquille glasses, are prismatic or lenticular. Some of the members present may recall the communication I presented to this Society on the evil results of using such glasses. I received at that time from various opticians by request packages of smoked glasses from their stock, and it was rare to find one which was not either prismatic or a concave sphere or thrown into waves like a piece of ice frozen in the wind. To sensitive eyes this is an additional source of irritation. I would say, in answer to what Dr. Lambert has just said about the special training for nurses, that for many years at the Polyclinic Hospital I gave lectures to the nurses on their duty in "nursing in diseases of the eye," so that it is part of their curriculum upon which they must pass an examination as much as in obstetrics and general surgery. I think it is of distinct advantage. In private practice when I want a nurse I always try to get one of our Polyclinic nurses because I know she has been trained in this special branch.

DR. C. D. WESCOTT, Chicago: Those of us who operate on the eye in general hospitals are in very undesirable relation to the nursing problem. Each time that we operate we may encounter a new operating-room nurse and each time that we dress a case we may have an inexperienced nurse assigned to us. At St. Luke's Hospital in Chicago, where several of us are on the eye staff, we have adopted a plan which is working out fairly well. We have a salaried gradu-

ate nurse who assists us in all of the dressings in so far as one nurse may. She superintends the preparations in the operating room by the pupil nurses. It has been said that such an arrangement is undesirable in that the regular nurses in training are deprived of some advantages thereby; but, on the contrary, the eye nurse has time enough to instruct these nurses personally in eye problems that otherwise would not be brought to their attention. Of course, all of our nurses have a regular course of lectures in nursing of the eye, but they do not have as a whole enough instruction.

DR. R. A. REEVE, Toronto: I think the resort to general anesthesia for a case, say, of cataract extraction with iridectomy, would certainly be necessary very exceptionally if one followed the expedient of injecting into the anterior chamber a drop or two of a 2 per cent. solution of cocain with perhaps a little adrenalin. That has been my practice for years, and I have never seen any untoward result whatever, and I am able to do an iridectomy in case of combined extraction without the patient suffering any pain. Then, in regard to asepsis: although I presume the majority hold their cataract knives in boiling water for a few seconds, there is a much more expeditious, and in one sense a safer, procedure—the almost instantaneous disinfection of knives by dipping them into boiling oil, a point which I learned in a visit to Sir Almroth Wright's clinical laboratory in London.

DR. SAMUEL THEOBALD, Baltimore: Only a word or two, Mr. President; I heartily agree with Dr. Gruening that the shortcoming which the ophthalmic surgeon has oftenest to deal with is upon the part of the patient, but as I had discussed this matter at some length in a paper published not very long since, I did not take it up in this paper. As to Dr. Lambert's suggestion about the need of special instruction of nurses in the care of ophthalmic cases, I may mention that we give a short course at Johns Hopkins in the Nurses' Training School, and I believe it is of some help; but the nurse needs, of course, something more than this before she becomes a practical nurse in an ophthalmic institution. She must have experience as well as theoretical instruction, and I agree with him that it would be admirable if this could be provided as a part of the curriculum of all training-schools.

MANAGEMENT OF CAPSULE IN CATARACT EXTRACTION AND AFTERWARD.

EDWARD JACKSON, M.D.,
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It is worth while to study methods of dealing with the capsule in the ordinary operation for cataract, or after that operation, both for the perfecting of these methods and for comparison of their results with results obtained by intracapsular extraction. In his paper read before the Society last year, Dr. Robert Sattler, speaking of the modified linear extraction of cataract in its present perfected form, said: "The means for delivery of the lens by opening the capsule and expressing its contents, leaving a more or less torn and not always empty capsule in the eye, have remained its weak and objectionable points."

In the discussion of intracapsular extraction, as performed and advocated by Smith, during the last few years, many operators have expressed the view that, if the capsule could be removed with the lens without increased trauma or danger, it would constitute an ideal operation and a great advance in the extraction of cataract. Not a few have even regarded operation on the remaining capsule as more dangerous, more to be dreaded, more likely to be unsuccessful, than the original operation of cataract extraction. This view is so totally opposed to my own experience with regard to capsule operations that it seems worth while to bring forward reasons for thinking it incorrect.

In his paper on The Treatment of After-cataract, Maj. Henry Smith (*Archives of Ophthalmology*, xxxv, p. 137) says: "Every one admits that, however successfully a cataract

may be extracted by the orthodox method by which the capsule is left behind, there is an after-cataract—an opaque capsule varying only in degree of density—and that if the patient is to have vision for fine work an after-cataract operation is invariably necessary."

Against such statements let me record the results of my last fifty cataract extractions done in private practice. Some of these patients are still under observation; all of them have been studied more fully than patients can be studied in a public clinic; and to settle a question of this kind they are worth more than an experience of thousands of cases discharged on the eighth or tenth day after operation. During the same period three cataracts were removed from blind eyes for the cosmetic effect, and two lenses were extracted with iridectomy for absolute glaucoma.

The first column gives the case number, the second the age of the patient, the third the vision obtained after the primary operation, the fourth the interval between the extraction and subsequent division of the capsule, the fifth the vision after division of the capsule, and the sixth the total length of time that the patient remained under observation after cataract extraction.

In this series attention may be called to cases 18, 27, and 28, in each of which vision of $\frac{1}{4}$, partly, was obtained by the primary operation, and continued without secondary operation, in one case eight years, up to the time of the patient's death, and in the others up to the present time, ten years and three years, respectively, after operation. In 22% vision of $\frac{4}{5}$ or better was obtained by the primary operation, and continued for the periods of one to ten years that the patients remained under observation. In addition 14% had vision of over $\frac{1}{5}$, sufficient for ordinary reading, which continued from one to eight years without any treatment for after-cataract. This is in pretty strong contrast with Major Smith's statement—"If the patient is to have vision for

Case.	Age.	V. after Primary Operation.	Interval before Needling.	V. Obtained.	Period under Observation.
1.....	59	$\frac{1}{5}$			6 months
2.....	39	$\frac{1}{5}$ pt.			7 months
3.....	63	$\frac{1}{5}$			1 year
4.....	72	$\frac{1}{12}$			2 weeks
5.....	77	$\frac{1}{10}$	2 months	$\frac{1}{5}$	20 months
6.....	66	$\frac{1}{15}$ pt.	6 weeks	$\frac{1}{5}$	2 years
7.....	72	$\frac{1}{5}$			3 months
8.....	63	$\frac{1}{5}$			3 years
9.....	65	$\frac{1}{15}$ pt.	5 weeks	$\frac{1}{5}$	1 year
10.....	63	$\frac{1}{5}$	8 weeks	$\frac{1}{5}$ pt.	4 years
11.....	81	$\frac{1}{5}$			6 months
12.....	65	$\frac{1}{5}$	2½ years	$\frac{1}{5}$ pt.	8 years
13.....	70	$\frac{1}{5}$ pt.			2 years
14.....	70	Closed pupil	2½ months	$\frac{1}{5}$	1 year
15.....	61	$\frac{1}{5}$ pt.	9 months	$\frac{1}{5}$ pt.	2 years
16.....	70	$\frac{1}{10}$			3 years
17.....	68	$\frac{1}{5}$			1 year
18.....	73	$\frac{1}{5}$ pt.			8 years
19.....	75		4 weeks	$\frac{1}{5}$ m.	1 year
20.....	68	$\frac{1}{5}$ pt.			6 months
21.....	78	$\frac{1}{10}$ ill.			3 months
22.....	78	$\frac{1}{15}$			3 months
23.....	60	Closed pupil	3 months	$\frac{1}{30}$	2 years
24.....	61	$\frac{1}{5}$ m.			1 year
25.....	68	$\frac{1}{60}$			2 years
26.....	68	$\frac{1}{10}$			2 years
27.....	58	$\frac{1}{5}$ pt.			10 years
28.....	65	$\frac{1}{5}$ pt.			3 years
29.....	54	$\frac{1}{5}$ pt.		Fell to $\frac{1}{60}$	2 years
30.....	48	$\frac{1}{60}$			2 years
31.....	63	$\frac{1}{5}$			2 years
32.....	71	$\frac{1}{20}$	18 days	$\frac{1}{5}$	3 months
33.....	43	$\frac{1}{15}$			1 month
34.....	74		1 month	$\frac{1}{4}$ m.	6 years
35.....	69	$\frac{1}{5}$			3 years
36.....	55	$\frac{1}{15}$	23 days	$\frac{1}{4}$	3 years
37.....	58	$\frac{1}{10}$			6 months
38.....	36	$\frac{1}{4}$			3 years
39.....	70	$\frac{1}{5}$ pt.	3 months	$\frac{1}{5}$	1 year
40.....	73	$\frac{1}{10}$	6 weeks	$\frac{1}{4}$ m.	4 months
41.....	58	$\frac{1}{5}$ m.			3 months
42.....	28	$\frac{1}{5}$	8 years	$\frac{1}{4}$	10 years
43.....	48	$\frac{1}{5}$ pt.			3 years
44.....	29	$\frac{1}{5}$			8 years
45.....	68	$\frac{1}{20}$	2 years	$\frac{1}{5}$	3 years
46.....	70	$\frac{1}{25}$	1 year	$\frac{1}{10}$	1 year
47.....	76	$\frac{1}{5}$			3 months
48.....	76	$\frac{1}{4}$			5 years
49.....	45	$\frac{1}{30}$			6 months
50.....	76	$\frac{1}{12}$			6 months

fine work, an after-cataract operation is invariably necessary."

Of the four eyes in which vision of less than $\frac{1}{10}$ was obtained, the following explanations must be made: Case 23 came to me with a history of injury to the eye three years before, followed by inflammation which continued for nine months. Three of five experienced ophthalmologists who had seen the eye advised enucleation. Five months before she came to me there had been another attack of inflammation that lasted for two months. The greater part of the pupillary margin was firmly adherent to the capsule. After the primary operation severe chronic uveitis recurred, which lasted for more than two months.

Case 25 had been blind about eight years, and had posterior synechiæ. Another surgeon had advised against operation. The history pointed to prolonged uveitis. After extraction vitreous opacities were discovered, and the optic disc presented a cup extending to its margin, and was surrounded by halo atrophy.

Case 30 came with the right eye absolutely blind from secondary glaucoma. The left eye showed a shallow anterior chamber with posterior synechiæ, except upward where there was a coloboma from iridectomy. The sight had been getting dim for fifteen years, and the eye had been inflamed five years before. After extraction the vitreous was found hazy, so that the disc and largest vessels were barely distinguishable. In Case 14 simple extraction of a large lens, with considerable damage to the iris and some incarceration, was followed by iritis lasting over two months, and resulted in closure of the pupil.

In cases put down as having vision of $\frac{1}{10}$ after the preliminary operation, Case 21 probably had better vision than this, but the patient was illiterate, satisfied with the vision he obtained, and no effort was made to determine the visual acuity exactly. In Case 26 the eye had suffered from uveitis.

In only one case (46), in which vision following the primary operation was less than $\frac{1}{5}$, was the impairment due to a pupillary membrane. In Case 49 there had been severe injury followed by inflammation.

THE CAPSULOTOMY.

The high visual acuity following the primary operation is emphasized because the method of opening the capsule, which I have followed for twenty-five years, is one that might be expected to be followed with especial frequency by a more or less obstructed pupil. It is a linear division of the anterior capsule at the upper margin of the pupil, making no attempt either to remove any part from the capsule or to cause it to roll back out of the pupillary space.

The incision is made with the knife used in making the corneal section, and necessarily opens the lens in a position exactly corresponding to the corneal section. After completion of the corneal section and the iridectomy, if that is to be done, and after a brief rest, the conjunctival flap is laid back on the cornea; and the cataract knife, dipped in water at the boiling-point, is brought with the middle of its back to the middle of the corneal incision and pushed into the eye to the position it occupied immediately after the counter-puncture. It is then drawn in the direction opposite to that in which it was pushed to make the corneal incision, until the point of the knife is just in the edge of the pupil nearest the angle of the corneal wound at which the puncture was made. The point is then depressed so that it passes into the lens substance, and the knife is pushed forward as for the corneal section until the point passes fairly behind the iris in the direction of the counter-puncture. This completes the opening of the capsule and the knife is withdrawn. For a time I tried incising the capsule with the point of the knife as it was carried across the anterior chamber before making the counter-puncture. But this interferes with the

smoothness of the corneal section, and on that account was given up.

The incision made by the above method is not a long one, usually only 3 to 5 mm. It might be thought insufficient to permit the free exit of the lens. I believe that it is usually extended each way by a tearing of the anterior capsule. However this may be, only twice have I been conscious of the slightest resistance from the capsule to the expulsion of the lens. In both of these cases the lens was hypermature and the capsule much thickened. In neither could the perceptible resistance of the capsule be regarded as a complication of the operation.

It would be expected, *a priori*, that after opening the capsule by this method secondary capsular cataract might be more common than after other current methods of capsulotomy. As a matter of fact it is not. I have used the method in more than 250 cases in which after-cataract has certainly not been more common than after the most elaborate operations for removal of the anterior capsule. The cases tabulated above give a fair sample of results. My observation is borne out by the experience of Herman Knapp, with his peripheric capsulotomy. Among 500 operations in which the anterior capsule was opened by the ordinary methods, or partly removed, the good results varied from 70 to 82%. With the peripheral opening of the capsule they rose to 89%, and in the subsequent 500 cases varied from 88 to 90.5%.*

I have had no opportunity to examine an eye removed after linear opening of the capsule, but it is established as definitely as any point in the healing of the eye after cataract extraction, by the observations of Becker, Norris, and others, that the remaining portions of the anterior capsule become adherent to the posterior capsule, closing off an intracapsular space which often has the form of a complete ring, and in which, in young subjects, some tendency to lens regeneration

* Trans. Amer. Ophth. Soc., iv, p. 422.

is manifest.* From observations of the eye during healing I believe that, in the majority of cases after linear incision of the capsule and the removal of the bulk of the lens, the anterior soon adheres to the posterior capsule throughout the pupillary space. The two layers become one membrane, which in a considerable proportion of cases undergoes no subsequent change that interferes with the patient's vision. Where small particles of cortex adhere to the capsule within the pupillary area, these are commonly absorbed in a few weeks, and the adhesion of the two layers occurs and may not be followed by subsequent deterioration. If considerable cortex remains within the capsule I make no prolonged effort to remove it, but do discission within three to six weeks after the primary operation.

An important superiority of such a linear opening of the capsule lies in avoiding any possible incarceration of the capsule; and dragging and irritation of capsular origin is one source of subsequent thickening of the capsule. Another signal advantage is the retention of any cortex remaining in the eye within the capsule, in which position it will not be a cause of iritis. In my experience lens cortex remaining within the capsule, even after the capsule is freely opened, causes no inflammatory reaction. It is when pieces of the cortex, even quite small ones, fall out of the capsule and come in contact with the iris that inflammatory symptoms arise. From the situation and character of the opening in the capsule any lens matter extruded from the capsule is almost certain to be pushed out through the corneal incision.

We would naturally expect that through a relatively small opening in the capsule the cortex would escape less freely, and this may be the case. It is quite possible that a series of eyes operated on by this method, if examined anatomically shortly after operation, would show a larger amount of cortex remaining in the periphery of the capsule than would a similar series of eyes operated on with freer capsulotomy.

* Photographische Abbildungen, Otto Becker, iii Series, plate xxi.

But the visual results and the examination of eyes after operation show that this method secures as clear pupils as are obtained by other methods of capsulotomy. If more cortex remains, it is in the periphery where it does no harm. It was pointed out by our fellow-member, Dr. T. B. Schneideman,* that after ordinary cataract extractions the upper part of the pupil is generally well cleared of cortex by "the mechanical action of the upward passing lens during its delivery." With the linear horizontal incision in the capsule, at the upper margin of the pupil, the anterior capsule receives the full benefit of this mechanical scouring, and is almost certain to be left free of adherent cortex. After expulsion of the lens through such an opening the pupil is left as clear, so far as the anterior capsule is concerned, as though that capsule had been removed.

AFTER-CATARACT.

But any operation that leaves the capsule within the eye will be followed in a certain proportion of cases by after-cataract. It is the reality or gravity of difficulties and dangers of dealing with opaque pupillary membranes that must finally determine whether it is justifiable to assume the increased difficulty and traumatism of intracapsular extraction. In the above series 34% of the cases underwent the secondary operation of division of the capsule by the single knife needle. This is the only operation that it is important to consider in this connection. In the last fifteen years I have done no other operation for secondary capsular cataract, and in that time I have divided as dense membranes as those which in preceding years I had attacked with de Wecker scissors, the Bowman double-needle operation, or extraction with the sharp hook. Other operations may sometimes be advisable, but so rarely that they have no important bearing on the

*Ophthalmic Review, 1895, p. 209.

question of extraction of the lens within or without the capsule.

In the above series, Cases 1 and 4 have been operated within the past year, and may yet require a secondary operation. Two of the patients were illiterate, and content with vision much below what might have been obtained by a secondary operation. Cases 25 and 44 had normal vision in the other eye, and did not desire a secondary operation, although opaque membranes developed within three and five years after the extractions. On the whole, about 50% of patients subjected to cataract extraction with linear opening of the capsule will at some subsequent time be better for a secondary operation.

That, in the minds of many operators, difficulties and dangers are associated with these secondary operations is undeniable. Such an impression has serious consequences. Within six months I have divided the pupillary membranes of a man who had been submitted to cataract extraction on both eyes fourteen and twenty-one months before. He had vision of $\frac{4}{2\,2}$, partly, in one eye and $\frac{3}{6\,0}$ in the other. For several months he had continued his attendance upon the surgeon who had operated, and who had changed his glasses, but had suggested no other relief. After division of the thickened membranes by single knife-needle operations his vision rose to $\frac{4}{5}$, partly, in each eye. Another patient, seen still more recently, came with vision of $\frac{2}{8\,0}$ after cataract extraction done three years previously. Division of the capsule has already given vision of $\frac{4}{1\,5}$, partly. Case 34 of the above series came to me with the history of having a cataract extracted from her other eye a year before. She had vision of $\frac{4}{2\,5}$, partly, that had not been materially improved by two needlings. An effective division of the membrane gave vision of $\frac{4}{4}$, partly.

These three cases were under the care of three different ophthalmic surgeons of large experience, all of them professors of ophthalmology in different medical colleges. These

and other cases encountered, as well as the allusions to the subject in the literature and in the discussions of secondary operations before medical societies, fully warrant the belief that the operation for secondary capsular cataract is often not well understood or efficiently performed.

One of the latest and best treatises on diseases of the eye, by our fellow-member, Dr. John E. Weeks, in describing this operation (p. 856) says: "The needle is made to pierce the cornea at a point between the center and the margin of the cornea, usually to the temporal side and near the horizontal meridian." A practically similar method, which is mechanically ineffective and surgically vicious, is described in the majority of standard text-books on ophthalmology. A few mention the suggestion of Kuhnt,* to enter the knife or needle through the vascular limbus. But none, so far as I know, except Dr. C. H. Beard, in his Ophthalmic Surgery, unreservedly advocates this method. In a paper published in January, 1898,† I pointed out "the need for overcoming the elasticity of the membrane and making as large an incision as possible in the division of the thickened capsule after lens extraction. The object here is accomplished by placing the corneal wound, which serves as a fulcrum, as far from the incision in the capsule as possible, and preserving the distance between them, by retaining all the aqueous humor throughout the operation, by using a needle with a shank large enough to fill the corneal incision.

"A second point is that, where there is to be much sweeping of the knife-needle, as for the division of a tough membrane, it is best to make the incision not through the clear cornea as commonly taught, but through the overlapping vascular tissue of the limbus. By doing this we lessen the danger of infection, as well as get a greater sweep of the blade. We know that injured corneal tissue is replaced by sound tissue

* Zeitschrift für Augenheilkunde, March, 1899.
† American Journal of Ophthalmology.

rather slowly, so that considerable time may elapse after a needle operation before the eye is safe from infection if the tissue about the corneal incision has been bruised in the operation. If, however, the knife is entered through the overlapping conjunctiva and sclera of the limbus the wound will be certainly sealed from external infection within a few hours, and the risks which have caused a needle operation to be regarded as more dangerous than a lens extraction will be almost entirely avoided. The plan of entering the needle thus peripherally I have employed, wherever practicable, for more than ten years, and have never seen serious disturbance of the eye follow it."

This is the first point in such an operation: to enter the knife through the limbus. Thus entered the danger of infection loses all practical importance, the movements of the knife become enormously more effective, and no deep disturbance of the vitreous can be caused in the region directly back of the pupil.

The next point is that the membrane must *be cut, not torn.* This has been insisted on by Herman Knapp and others, and theoretically is generally accepted. But it has not always been remembered that with a properly shaped and perfectly sharp knife-needle it is quite possible to tear a membrane instead of cutting it. If the force be applied not exactly in the direction of the cutting edge, but somewhat sidewise, the point will catch in the membrane and drag on it until it tears without any real cutting. Even if the force is exerted exactly in the direction of the cutting edge, if this be simply a steady drag, instead of a to-and-fro sawing motion, no cutting is likely to occur. The keenest knife edge when magnified appears serrated—saw-like. No one would think of cutting with a saw by merely pressing the edge against the wood or bone, although it will make rapid progress with the usual to-and-fro movement. When it comes to cutting a thin membrane the size of the projections on the keenest

knife edge becomes relatively great, and an actual cut is only accomplished by the sawing motion; and the stroke must be long enough to allow for the to-and-fro movement of the flexible membrane.

Because of this need for a sawing motion the cutting edge must have considerable length—not less than 6 mm. In this respect the form of needle having a cutting edge of 9 or 10 mm. proposed by the late Dr. Isaac Hays, in 1855,* and in use ever since in Wills Eye Hospital, Philadelphia, is one of the best. The similar knife with a cutting edge of 7 mm. carefully proportioned and advocated by Dr. S. L. Ziegler, and commonly known among the instrument makers by his name, is equally good. The proportioning so that the shank shall just fit the cut made by the blade and prevent escape of aqueous is an important point. The shortness and convexity of the cutting edge of the Knapp knife-needle are points of inferiority for this purpose. A needle with a concave cutting edge has also rendered me good service.

Third: Two incisions must be made in the capsule so as completely to join each other at an angle. A single incision, or isolated incisions that do not join, may gape nicely so long as the vitreous is pushed into them by pressure on the eyeball, but after the operation is over the two sides of the incision usually come together and the clear space obtained disappears. When, however, two such cuts actually meet at an angle, the included portion of the membrane retracts sufficiently to prevent reunion, and the opening is permanent, the retraction increasing with time. In order to get two incisions of this kind in the pupillary membrane, it is essential to make the second by cutting toward the first. The crucial incision sometimes advocated is not practical. It can be imitated by making a cut to the original incision from each side, but two incisions properly made will generally serve as well as a greater number. I have formerly advocated the

* Amer. Jour. Medical Sciences, vol. xxx, p. 81.

T-shaped incision, but a better shape is that approximating the V, as urged by Dr. Ziegler.

It is well to plan the incisions in the membrane so that they will serve to release any tension on the iris through posterior synechiæ. When on any account the needle has been entered at the wrong point it can be withdrawn, and entered at the proper place and the operation proceed normally. Sometimes one cut can be made best from one point of entrance, and the second cut from a different point. If the shank properly fills the opening so as to prevent escape of aqueous, the needle can be withdrawn after the completion of the first cut, reintroduced, and the second cut made. I have in this way made two punctures into the anterior chamber at one operation without embarrassment from loss of aqueous or subsequent bad effects.

In none of the above cases did the operation need to be repeated or fail to give the desired result. I have never seen it followed by serious reaction or other unfavorable sequel, except glaucoma in two cases. The eye is kept closed for a few hours, and under the influence of atropin for a few days. It causes no more inconvenience than the removal of ingrowing lashes, and is attended with less danger than removal of foreign bodies from the cornea. The fact that such an operation may be required in one-half our cases of cataract extraction seems to me an insufficient reason for adopting the more serious and difficult operation of intracapsular extraction of the lens. Nor are there difficulties or risks connected with division of the capsule that offer any excuse for allowing patients to go with vision impaired by membranous opacities.

SUMMARY.

In extraction of cataract, linear division of the capsule at the upper margin of the pupil avoids the inflammatory complications liable to arise from incarceration of the capsule or the presence of cortex in the anterior chamber, and gives

as good visual results as are obtained from the primary operation by any other means of opening or removing a part of the anterior capsule.

Capsular after-cataract sufficient to justify division of the pupillary membrane arises in 50% of cases so operated upon. Division of the pupillary membrane is a safe, efficient operation, causing little pain or inconvenience if done with a knife-needle of the Hays-Ziegler type, entered through the vascular tissue of the limbus, and made to cut by a to-and-fro movement and form two incisions in the capsule that entirely join each other at an angle.

This method of treating the capsule in connection with cataract extraction seems to be easier, safer, and more certain to give a useful eye than any other method now in general use for senile cataract.

THE RELATIVE VALUE OF RECENT IMPROVEMENT OF CATARACT EXTRACTION.

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The last two decades mark no uncertain evolution for cataract extraction.* During the second, only, have adequate proofs accumulated which again justify a reconsideration of the ideal aim to extract a cataractous lens in its capsule. Until then, for evident reasons, its justification was denied and its expediency even questioned. As an emergency measure it is now, as it was then, sanctioned. For the reason of its unsafe and difficult technical exe-

* Safer and more facile technical improvements have replaced, only, however, after stringent and disinterested trials, the methods which, by consent of experience, were unsatisfactory or had failed wholly or in part in their purpose of achieving for individual or common effort an increasing proportion of successful and lasting results. Of these methods, as such, none has undergone a more progressive advance than the one of linear extraction, which for so

cution, however, its use from choice or selection was restricted to a few cases and operators. Since then more convincing information concerning its safety and practicability is at hand, which to all fair-minded observers entitles it to a disinterested comparison with the advantages and imperfections of extracapsular delivery.

Stripped of all its objections the fact stands that, of the newer methods, compared to the similarly used means to accomplish this purpose of older methods of extraction, the operation of Colonel Smith, of Amritsar, India, directs along wholly new and different lines, a lens delivery in its unbroken capsule. It is claimed for this method that its opening incision is bloodless, the iridectomy smaller and attended by a lesser amount of hemorrhage, and its lens delivery a joint removal of its capsule and entire contents, securing thereby a permanent and complete clearance of the pupillary area. The lens, in its passage, owing to its smooth and intact capsular envelop, does not bruise the opening wound, and dreaded complications, resulting from broken or retained lens substance, with its subsequent solution, swelling, and mechanical irritation, are prevented. Iritis is infrequent; recovery is more rapid.

Let me, briefly, state what my personal experience with this method has found either advantageous or impracticable.

long has been and still continues to be the almost universal practice; for the reason of the safer and easier technical execution of its opening incision, iridectomy, capsule opening, and lens expression—and this in spite of the commonly admitted inefficiency of its lens delivery.

Were it not that the superiority of other features of its technic equalizes or even outbalances the unsatisfactory means it directs for disposing of the lens and its troublesome capsule, the distinction it now enjoys for safety to the patient and more uniform percentage of successful restorations of vision, as well as remaining the operation of choice for us, would be forfeited; and this would be the case if common and individual experience did not support the preceding statement. If we admit this, and facts in abundance bear out its truth, so far as the modified linear method is concerned, an equal improvement must be ascribed to the methods which, as part of the same or of a different technical execution for the opening incision and iridectomy, suggest new means for the delivery of the lens in its unbroken capsule, and thereby eliminate successfully and permanently the complications so well known and so impossible to avert by its substitute of capsule opening and expression.

In execution the initial section is not more difficult, but even for those of accurate vision and acquired deftness from larger experience, the opening wound in the clear cornea cannot be estimated with the same accuracy for amplitude as the more peripheric one of the modern linear method. If the cornea is small, and one must prepare for a larger incision, it is necessary to place its height or apex much nearer to its upper margin than the method prescribes. If the puncture or counter-puncture is at or near, or, as more specifically directed, one-half the knife's breadth below the horizontal diameter of the cornea, the incision comprises almost one-half its circumference, with greater jeopardy to its nutrition.

If, for evident reasons, an operator realizes that the opening incision is too small, he can gain amplitude only by approaching its upper margin. In so doing he sacrifices the main advantage for delivery in an intact capsule by this method, as the overhanging ledge of the cornea acts as a support or buttress for the pressure movements necessary to extrude the lens in its capsule. At the same time there is a less desirable wound coaptation and greater danger from coccal and bacterial infection. A less objectionable consequence is the high astigmatism which often results. The objections to the iridectomy are many, but certain advantages as part of the complete sequence of the operation must be ascribed to it also. If performed as suggested,* less hemorrhage obscures the field of operation, a smaller area of the iris is excised, the resulting coloboma is small, often triangular, and upward displacement of the pupil subsequently is not an infrequent happening. Should com-

* The smaller iridectomy at the time and as a part of the Smith method facilitates, more than even a preliminary iridectomy, the successful and uncomplicated delivery of the lens in capsule; nevertheless I advise and practise, if possible, a preliminary iridectomy six or eight weeks prior to lens extraction, even though it may offer, and I am convinced it does, an added obstacle at this later period. It is, however, the best means to insure greater safety and to prevent what is so common, the upward displacement of the pupil.

plications occur during or after lens delivery, *i. e.*, rupture and retention of the capsule or loss of vitreous, iris retraction and agglutination follow, and, if no more serious consequence develops, marked displacement of the pupil upward results, interfering with practical vision and subsequently necessitating iridectomy or iridotomy.

The pressure movements made with the blunt end of a large hook against a smaller and limited area of the cornea differ in purpose and force so completely from the similar ones of the extracapsular expulsion with Daviel's spoon that one, who has well in hand the latter pressure movements from frequent experience, must prepare himself to forget or ignore what long familiarity and cumulative touch have taught him. To dislocate or slide out of its capsule, which has been opened with cystotome or forceps, its partial or complete contents of lens substance requires, in most cases, little pressure and less skill. To dislocate a lens from the hyaloid fossa in its unopened capsule is an altogether different undertaking, as difficult a part of the newer method as it is easy of execution in the older one.

One must remember that the pressure movements have a different purpose, not to slide out of a torn and more or less resistless capsular envelop its contents, but to preserve its resistance and at the same time its smooth and elastic form, and, through pressure deftly applied with the force which experience alone can furnish, break or detach at one point above or below, its zonular attachment, and only when this is certain, follow it up with the same localized uniform pressure until complete extrusion has been effected. In a general way it may be said that to dislocate and detach from its zonula a more or less thick or globular lens is easier and requires less forceful pressure than to cause the extrusion of a flat, sclerosed, or thin lens. In any event an operator must be prepared to exert pressure with an unfamiliar instrument, which must and will at first appear to him exces-

sive in degree and direction of the force applied and almost unwarrantable, even if compared to the pressure he must have exerted in the most difficult attempts to slide out of a torn capsule the most sticky and adherent lens substance. On the other hand, if he successfully lands the lens in capsule he need have no fear of his patient, for the complications so dreaded and evil in their remote consequences are thereby prevented, as no operator can be certain that if the capsule has once been opened, he has really emptied it of its entire contents.

To offset this statement those unfamiliar from personal experience may say that accidents at this critical stage of lens delivery, such as an early rupture of the zonula with loss of vitreous, bursting and retention of the capsule, or escape or dislocation of part or of the entire lens substance, are and may prove complications more to be dreaded than the much less difficult pressure manipulations of an extra-capsular extraction, even granting the probability of certain postoperative disasters. This is undeniable. In its favor, however, it must be said that extraction in capsule must be accorded a higher surgical and visual success for us, and for the patient, a safer and shorter period of recovery. Even with this or more in its favor, it is at present supported mainly by the efforts, enthusiasm, and limited practical experiences of a smaller contingent of our number. Before it receives more general sanction or support common experience must abundantly confirm this.

It is, after all, not a question of method as such, but rather of that of the individual. He who can convert through his own mentality and experience the best of one or all methods to his use and thereby achieve safer means to further or accomplish practical and desirable aims, will contribute his share to a higher evolution of that which is in general favor for its intrinsic merits. It means greater certainty—a higher proportion and uniformity of success.

Silently we may pass over the quibbling indulged in by the exclusive adherents of one or the other method on two important questions. The first, what should constitute our standard of visual restoration after an extraction safely conducted for our patient? and the second, is it possible to determine or diagnose with certainty before an operation what the size or texture of the lens is, or what the strength or weakness of its capsule may prove itself to be?

In answer to the last question, and so far as it applies to those cases in which choice might select the intracapsular method, I frankly admit my inability in a given cataract case to be able to diagnose with certainty more than that a floating nucleus may be present, that the lens is flat and thin or rounded and thick, or that the opacity is partial or complete, but to hold with certainty that the texture may be harder, softer, or brittle, or that the capsule is fragile or resistant, is beyond my knowing until its actual proof and presence are disclosed to me as the operation proceeds. Reliable but not certain conclusions can be drawn from a careful antecedent study of the cases in question. The disclosures of a preliminary iridectomy add much, and often determine and direct the expediency of an intracapsular delivery. But even in such favorable cases a much lowered physical standard from advanced age and other local and general causes precludes its expediency and assigns preference to an extracapsular extraction.

It is of lesser consequence whether the opacity is complete or incomplete. Much has been said in favor of this method for so-called immature cataract, excessively slow to advance or "to ripen," and for which diverse surgical expedients, bad and indifferent, have been proposed and practised. Such cases of interminably slow immature cataract make up two distinct groups: The first includes those, mostly in subjects under sixty, in whom the lens is lighter in color, the body of the lens thick and more or less swollen, the

capsule adherent and resistant, the opacity apparently stationary or advancing with almost imperceptible slowness. For such cases my experience strongly points to the advisability of considering an intracapsular extraction. In the second group, which comprises principally subjects past sixty, the lens grows darker in color, from deep amber to black, the body of the lens large in dimension, hard in texture, flat at its anterior pole, and angular at the equator, the capsule not adherent, the opacity incomplete, and the progress seemingly interminable.

For the cases of this group there is positively no justification for the intracapsular method, and its expediency even should not be sanctioned, as extracapsular delivery accomplishes, along safer and more facile lines, a larger percentage of perfect and partial successes.

The equally important first question, whether we should strive in every case for nothing more or less than a complete restoration of the normal standard of vision, and, unless this is achieved, to consider either the surgical method faulty or our efforts unsuccessful because an ideal and next to impossible uniform result was looked for.*

Generally speaking, our complete and partial successes, in which a full or approximate normal restoration of vision is brought about, happen in subjects that physically and psychically represent a higher and better preservation of general and local nutrition, or at least we note the absence

* A cataractous eye is one which, with other organs of the body, shows the wear and tear of uninterrupted functional activity, with the same or similar attendants, nutritional and degenerative, of increasing senescence and local arteriosclerosis and general cardiovascular ones. Many of our patients, even without the usual inroads of senility, have but a limited period to live after a successful operation. We all know how difficult it is to keep a reliable record of visual results for those patients with whom we remain in touch and how impossible with those who live in and return to inaccessible localities and are lost to us for subsequent accurate observation. We can assume, also, that for the largest number their non-appearance or our failure to communicate with them is that senility has added to their infirmities, physical and psychical, or that death has claimed them, or that they are satisfied with whatever visual restoration was achieved.

of gross cardiovascular changes. We must accept our cases as they come, in their regular order of sequence, a goodly proportion with favorable eyes for operation, in sound individuals with more or less normally preserved health and strength; a similar proportion with favorable eyes for operation but in unsound bodies; and again, many unfavorable eyes in equally infirm subjects. Our own judgment and experience must decide in favor of one or the other method, as every case functionally sound must and can be operated upon.

One and all expect us to succeed in our efforts to restore their vision. This brings us to the final issue of the question, that we have no definite or reliable diagnostic means to discover, before an operation is undertaken, the texture of the lens and the resistance of its capsule, which enable us to decide positively in favor of the one and deny the justification of the other. That with the knowledge so far gained we must consider the intracapsular delivery as safe and justifiable in certain cases only, in which purposive selection points to it as preferable from choice and expediency.

II.

The pertinent facts of extracapsular lens delivery as part of the modern linear method are too well and too generally known to need repetition, and only the newer improvements which have attracted larger attention or have been practically tested will be referred to. These include suggestions: (1) To revive simple extraction. In Vienna, where it is much practised, it is known as "Hess' modification." Similar procedures have long been known and practised elsewhere, before and since. After lens expression through the normal (dilated) pupil a small perforation of the periphery of the iris, equivalent to a small iridodialysis, is made. After this further efforts at lens expulsion are resorted to, extruding

any remaining concealed detached lens substance through both pupil and artificial opening. At the accepted finish, however, an operator is uncertain that he has completely emptied the capsule of its contents, for the field of operation is now more or less covered by the contracted pupil and the very small opening in the iris near the periphery. One can assume almost with certitude that concealed larger lens masses remain hidden under the perforated iris, and these are impossible to detect, much less dislodge. The rather shallow claim that this small peripheric opening affords a ready and desirable means for the spontaneous escape of aqueous humor, and even remaining smaller, softer lens masses after the operation, thereby preventing iris incarceration and prolapse, etc., does not stand against certain well-taken and confirmed objections. Foremost among these are: In order to facilitate the small iris perforation, the opening section must be at the limbus, the flap of bulbar conjunctiva either very small, or it must be entirely abandoned. A lesser objection is that the capsule cannot be so satisfactorily opened with forceps or cystotome; but as this is a matter of individual skill, it deserves passing notice only. The passage, however, of a more or less hard lens, rough, and often broken off at its margin or surface, must necessarily cause greater bruising of the upper part of the iris and often tearing of its pupillary border. Iritis is a more certain consequence, posterior synechiæ and capsular thickening are more frequent, and the desired aim of a more or less round, mobile pupil more often thwarted than realized. A small preliminary iridectomy or even complete iris excision at the time of extraction is more rational from a surgical viewpoint and infinitely more safe for the patient. Individually, I should prefer to return to simple extraction as such, without the iris perforation of the newer suggestion, if former experience had not conclusively proved to me its objections as compared with a complete iridectomy.

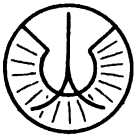
Recently, also, preliminary capsulotomy has been suggested. It is a revival of a long-forgotten procedure. As a preliminary expedient with older subjects there is no just reason for it, as even a slight swelling of the lens, as well as the resulting irritability of the eye following the surgical traumatism to effect it, are both unnecessary impediments to a contemplated extraction which must take place one or several days later. In sclerosed lenses there is absolutely nothing gained by such preliminary interference of the capsule, as the lens does not swell in this short period of time, and for most cases of this class experience, in any event, predicts an easy separation of lens and capsule. It is positively unjustifiable when the lens is swollen, with probable union of the capsule and adjacent cortical layers and with a shallow anterior chamber.

In most cases of this latter group preliminary opening of the capsule would only complicate or render impossible a liberal opening incision, besides inviting other more serious complications. Preliminary capsulotomy in subjects under thirty, with complicated or traumatic cataract in one eye, in whom, mainly for cosmetic purposes, extraction is permissible and functional examination justifies it, will prove a measure of useful expediency, and I have repeatedly practised it recently, with the most satisfactory results, but only for the cases of the latter group.

Among the newer or revived procedures to open the capsule for lens extrusion those which extol the advantages of the capsule forceps over the cutting cystotome deserve first mention. In the use of the forceps an operator may count upon his own ability to carry out the specific aim of its selection, *i. e.*, to bite out and remove a central portion of the anterior capsule and thereby secure a permanent opening, but in this attempt he is more often thwarted than successful; for the flatness of the anterior lens surface and the smoothness of the capsule oppose obstacles which his

skill and ingenuity cannot overcome. Even if two vertical linear incisions with a cystotome are made to precede it, it may prove difficult and impossible to seize the intervening capsular area in the bite of the forceps. For the reason that the most expert and cautious use of the forceps furnishes only an approximate or smaller uniformity of successful efforts, my experience suggests that freely and successfully to open the anterior capsule main reliance should be placed upon the use of a cutting cystotome. A capsule forceps should always be at hand, but it should supplement rather than replace the cystotome. The one preferred by me cuts, not tears, the capsule, and to accomplish this successfully the best artificial or focal illumination is necessary. Formerly the T-shaped incision or opening was carried out, but for a much longer period since then the following procedure has been practised.

This has reduced for me the frequency of secondary cataract and is also a more certain preventive of closure of the original opening. The cystotome is passed well under and behind the iris below, and two converging straight or crescentic incisions are made in the capsule, under the guidance of magnification and thorough artificial illumination, and completed by a single vertical one. Only if the delivery of the lens is prolonged and difficult is a transverse linear incision concentric with the equatorial zone added.



III.

An impartial and more extended comparison of the two methods of the total and consecutive number of my extractions upholds the claim of greater safety for the patient and operator of extracapsular delivery as part of the modern linear method.

Taking for accurate comparison an equal number of perfect visual results by either method, in subjects with

fair physical preservation, *i. e.*, restoration of full normal vision for distance and reading purposes, I found them equal in every respect. The intracapsular ones were first and final successes without, and the extracapsular ones only with, post-operative surgery in more than one-half by this method.

An equal number of both, of partial successes but with restoration of vision not below 0.5, and in which subsequent surgery was as often necessary in both to restore it, I found a higher average of visual acuity and lesser dangers from post-operative complications among the extracapsular ones.

Those cases by either method in which vision dropped below 0.5 but not under 0.3, and in which further surgery was uniformly necessary to effect this, were also in favor of extracapsular delivery, for the reason that the complications of the intracapsular at the time of extraction and the subsequent ones were more grave and tedious in their consequences than those following the former.

My perfect results are numerically in favor of the old method, and a higher percentage of partial successes also outnumbers those of the new or intracapsular method.

A perfect result of the intracapsular method is surgically, from my point of view, a higher achievement, but in visual perfection is no better than a similar one by the extracapsular procedure.

We are safer in the choice of the extracapsular method for most cases, but if we resort to deliberate purposive selection we will discover many cases, even in the absence of definite diagnostic means, which justify and even direct an intracapsular operation.

My experience has also convinced me that certain cases, such as the brief history below recites,* are more success-

* The patient, a woman of sixty-seven, under observation for more than twenty years. Ten years ago a double iridectomy for recurrent uveitis of gouty origin with fundus and vitreous changes assisted and improved her declining vision. Since then slowly progressing sclerosis of both lenses has come about. The anterior capsule is studded with deposits, the posterior surface of the cornea opaque with localized precipitations, but tension and functional

fully restored through an intracapsular delivery. To laud the intracapsular as alone indicated for immature cataract or slowly advancing sclerosis lentis will, I am confident, be protested in the light of a larger experience. I have found it positively unsafe in very old subjects with desiccated, flat, and hard lenses firmly implanted in the hyaloid fossa. To extol its superiority to the exclusion of the other method, and assert that it may become the operation of choice for our more or less limited contingent of cataract cases, appears at present improbable. But that intracapsular delivery after Smith's method will stand and hold its place in ophthalmic surgery on its own and distinctive merits, and that it is justifiable in certain cases and not too difficult for the average operator I confidently believe, and that this will be confirmed by an increasing number of surgeons after it has been submitted to an impartial trial.

At one time an enthusiastic follower of simple extraction, I happened twelve years ago to compare the visual and surgical results of twenty-five of my best simple extractions with the same number of the combined operation, and at that time discovered the rather disappointing fact of the absolute shortcoming of the former. Comparing fifty consecutive operations of each with their proportion of perfect and partial successes and failures, I had convincing proof of its inferiority. The combined operation eliminated or reduced imperfections, complications, and difficulties which my own experience at least found impossible to avert or overcome

examination justify further surgery. Intracapsular delivery through a broad corneal section was done first in one eye and later in the second eye. Both lenses showed capsular thickening and opacities, especially in the equatorial regions and at the anterior and posterior poles. To have opened these capsules and forced the extrusion of the adherent contents would have exposed the patient to certain dangers, a tedious recovery, and uncertain visual results. At present she has vision in both eyes which enables her to go about alone and to read large print with a hand-magnifier. The vitreous is full of the old opacities, but the posterior face of the cornea has been cleared of its blotchy precipitates. In this case there is no question that intracapsular delivery with all its risks was alone justifiable, and that the linear method with lesser hazards involved a more uncertain outlook.

with simple extraction. Nevertheless, a smaller number of the total of simple operations were cosmetically and surgically realizations of the desired aim; numerically, however, they furnished a smaller number of perfect visual ones and a lesser number of partial ones, with a lower average of visual acuity than the same number of the combined operation.

The improved features of modern extracapsular extraction which have furnished me with the best results are, first, to make the more or less peripheric opening incision ample for any emergency and with as large a flap of bulbar conjunctiva as possible. If possible, I advise and practise a smaller preliminary iridectomy. It has the double advantage of eliminating iris hemorrhage at the time of extraction, and the greater one of affording the operator unmolested guidance of the cystotome or capsule forceps or both, under concentrated illumination, and this should invariably be resorted to. The anterior chamber is not irrigated, but I am deliberately slow in my efforts to expel the contents of the capsule after I am convinced, through my own vision, if necessary aided by magnification and always under thorough artificial illumination, that a sufficiently large capsule opening is made.

If the newer suggestion of a peripheric iris perforation again attracted me to simple extraction, it was shortly abandoned, as even a limited experience convinced me of its many objectionable features, and that to achieve an indifferent cosmetic effect one must modify or sacrifice what experience has abundantly proved insures safety for patient and operator.

Preliminary capsulotomy in senile subjects I am opposed to, but consider it justifiable and expedient for certain operable cases of unilateral cataract in younger subjects. Opening of the capsule I practise invariably under the guidance of full artificial illumination, and this applies with

greater emphasis to all operations for secondary cataract. In discission of post-operative capsular thickening I often resort to a second introduction of the knife-needle through the vascular limbus, only making a second linear cut at right angles to the first.

The portentous gravity of even minor surgical interference for the betterment of secondary cataract is so fully impressed upon me that precautions are doubled and surgical traumatism reduced in every possible way by cutting, not tearing or pulling, and to limit incision to linear opening of the opaque and thickened capsule. To avoid the deeper penetration of the knife-needle into the posterior capsule and hyaloid envelop is a safe and sane admonition for every operator. I know that I have added to my own worriments in that I have reduced partial successes to lesser ones or even to complete failures by the post-operative surgery resorted to in an effort to improve, often contrary to the patient's wishes, the sufficiently useful but not perfect vision, but which was considered short of a cherished standard.

I have long adopted different standards for that class of my patients represented by the aged and physically infirm, such as inmates of infirmaries, laborers, etc., for whom a restoration of useful vision which approaches or exceeds 0.5 is sufficient for their needs, and I emphatically discourage further interference. For mechanics and professional patients who are ambitious to resume work, and whose physical and mental condition permits and justifies this, the highest standards of visual restoration are upheld, but even for this class, if it reaches 0.7, I discourage additional surgery on general principles of safety, but until this has been achieved, employ every possible means to bring this about.

DISCUSSION OF PAPERS OF DRS. JACKSON AND SATTLER.

DR. S. LEWIS ZIEGLER, Philadelphia: The points raised by Dr. Jackson in his paper are very interesting and very

practical. There are many methods of making the incision in the capsule, which I have preferred to call cystotomy, but the shape of the incision that I have always employed has been that of the Greek letter Pi. The first incision is made vertically from below upward on the right side of the lens; the second incision is made vertically from below upward on the left side of the lens, and a final incision is made horizontally at the periphery of the lens, above, to join both of the vertical incisions. This gives you a large anterior flap of capsule which drops out of the way underneath the lower edge of the pupil. In that way it avoids union with the posterior capsule to increase the secondary cataract, and at the same time gives a free exit of the lens and cortex.

I might also refer to the cystotome which I have devised, because I believe that the principle of cutting the capsule, which Dr. Knapp emphasized so much, is preferable to any tearing of this membrane. The Graefe cystotome as generally employed is a tearing cystotome, and the hook-like fleam may easily dislocate the lens. I have, therefore, had made a heart-shaped cystotome with a double bevel, the lower margin having a knife-edge, the upper margin being dull, with a bevel through the center, somewhat like my double-beveled keratome. This bevel preserves the sharpness of the lower edge, while the upper edge is dull enough to avoid any danger of scratching Descemet's membrane. The shank is malleable, so that the cutting head can be bent out of the way in making the incision. I have never published a description of this instrument, but Dr. Fox showed an illustration of it in the collection of cystotomes which he presented before the American Medical Association five or six years ago.

If, on the other hand, we prefer to do cystectomy, I think that the blade of the capsule forceps devised by Mr. Collins, of London, is probably the best. I have joined this blade to the form of forceps devised by Pley. The shank of this forceps is made in the shape of a double bayonet with the sharp teeth placed on the end of the bayonet. You can excise a piece of anterior capsule much cleaner by this method than by any other that I know of.

The preliminary cystotomy, which Smith and Fridenberg

have recently discussed, may have some advantages in certain immature cataracts. My attention was first called to this procedure soon after I presented my paper on iridotomy by several surgeons writing to me that they had used my knife-needle to make a V-shaped incision in the anterior capsule (preliminary cystotomy) some days or weeks before the extraction. I tried the procedure a few times, but the result did not particularly impress me. I think the experience of Dr. Fridenberg, Dr. Hansell, and others should lead us to try this measure.

The method of cystotomy that Dr. Jackson employs with the cataract knife has the advantage of being a true cutting incision. I presume we all know that Trousseau made a similar incision with the cataract knife, excepting that he did it while he was making his corneal incision for the extraction. He passed his knife through the cornea, dipped it down into the pupil, going through the capsule and out again, passing on through the cornea and completing his incision. That was all of his incision, and practically the only instrument he used for cataract extraction, as he did the simple operation. This is the same incision that Baron Wenzel used many years before for both cataract and iridotomy. As to the visual results, I think that they are always relative and depend as much upon the refractor as upon the operator. You may have a beautiful operation, but your assistants may not succeed in getting a good visual result, whereas if you sit down and do a careful refraction yourself you will probably find that you have secured perfectly normal vision.

Coming now to the operation for secondary cataract, I believe that V-shaped capsulotomy has the advantage over other incisions. I prefer the puncture, as Dr. Jackson emphasizes, in the periphery, at or beyond the corneoscleral junction. I still prefer a 7 mm. knife-needle in order to secure a long leverage and ease of incision. By making the puncture above and passing the knife-needle toward the bottom of the anterior chamber, you secure a long leverage, your knife does not enter into the vitreous so far, and if there is any opacity of the cornea, you can avoid that area in making your artificial pupil. The question of repuncture of the membrane that Dr. Jackson has referred

to is also very important. Sometimes you will make a very beautiful incision, and at one point, say at the tip, the iris may be fastened to a very stiff piece of capsule, and, while the sides of the V will recede beautifully, the apex will not recede at all. By making a quick puncture of the base of the flap at one side and gently sawing across, its base will be broken and you can turn it down and back. One point in regard to repuncture of the cornea: Occasionally the first line of your incision opens freely and the other one does not, for some reason, possibly because of reduplication of the membrane by inflammatory deposit. If you will withdraw your knife-needle, make a lateral puncture of the cornea at the opposite side, and again puncture the membrane at the periphery on the closed side and cut across the membrane on that side, you will get a much better opening of the pupil.

Now as to the Smith-Indian incision, which is the same that I saw Dr. Strawbridge use during the two years that I was Resident Physician in the Wills Eye Hospital (1887–89), and is made in the same way that Mauthner made his, I think it has its advantages and disadvantages. It has, as Dr. Sattler has said, the advantage of holding in the structures behind. Nevertheless there is almost always an overriding of the wound margins, and it is slower in healing, because in making the incision you turn the knife at right angles in coming out, making practically a wound with square edges that will move backward and forward with every movement of the eyeball, and thus delay healing. If the slightest bit of capsule gets into the wound, you will also have delayed union.

In my early cases of intracapsular extraction I made the regular Smith incision, but I later reverted to the usual peripheral incision, and I have had equally good results both visually and in the delivery of the lens. The problem of dislocating the lens I think is a mere trick. Dislocation of the lens can be done by a quick thrust of the lens-hook, just as in making the membrane puncture in V-shaped iridotomy, only you do not let the instrument go far enough to do any harm. In the same way you make a quick thrust backward with the point of the lens-hook, stopping when the lens begins to yield. The lens is immediately dislocated and extruded with ease.

DR. C. H. BEARD, Chicago: As I understand Dr. Jackson's linear cystotomy, it is in effect the same as Knapp's peripheral cystotomy. Now, in most of our cases of extraction we do not have at any time a large pupil; and, if I am not mistaken, to make a cystotomy through an ordinary pupil with a cataract knife would of necessity limit the extent of the incision considerably. Dr. Jackson's cystotomy must be within the limits of the pupil. With a large peripheral capsulotomy, by using a straight shank cystotome, and with a rounded beak to it, one can pass it behind the pupil after putting it in with the back of the knife downward, then giving a quarter of a turn, and with the point in contact with the capsule one can begin the incision behind the iris on one side and end it behind the iris on the other side, and then give another quarter turn and bring the instrument out at the incision back first. That is virtually the same incision, and we all know that when once an incision in the capsule is started it becomes the center of tributary tears and ruptures, and just how it is going to end is problematical.

This thing of making multiple incisions in the capsule to form certain designs has always seemed absurd to me. I think if we were to be able to see our incision and to note just what we are doing, that many of us would be surprised to see the result of these so-called geometrical figures in the capsule. I believe there is a good deal of moonshine about it. When you have made the Knapp peripheral incision you at once see the lens pop up, and when it pops forward it tears the capsule in different directions, so that when once it pops up from a single incision, to attempt other incisions that cross it or that meet it at different points only results in promiscuous laceration of the capsule. Also, in regard to the after-cataract. I think the single incision there is all that is necessary. My preference for the knife for this secondary operation is really a diminished form of Graefe knife. I have for a long time used for this purpose the worn-out Graefe knives, which to be properly formed should be one continuous wedge shape. The great tendency in the wearing out and constant repairing of the cataract knife is to give them a shape which is very pernicious for a discission knife, because the broadest part of your knife is at its middle. The tendency of the instrument-maker is to whet

the knife away toward the shank and leave it wide near the point, and when the broad part of the knife has passed your incision, then comes the narrow part which does not fill the incision and out goes the aqueous. It is important to have your anterior chamber intact, because when the aqueous escapes the eye becomes like a rag, and the nicest cutting of the membrane is impossible. I say that the manufacturer should make the knife a gradual taper, a constantly increasing wedge, so that at every point it blocks the incision. Moreover, instead of having this old ground-down cataract knife sharp all the way along, I recommend having a sharp point, a sharp edge 5 to 6 mm., and the rest of the edge perfectly smooth and dull. I agree with Dr. Jackson as to the best method of entering a knife. I even go to the further extreme of starting it in the conjunctiva and entering the anterior chamber by way of the opaque portion of the cornea. With such a knife passed along the anterior chamber to the point where you want to begin your cut, the dull portion of your knife is not only engaging your cornea and iris, but gives the opportunity to give a sawing motion. You can give this sawing motion without cutting the iris or cornea. As regards the discission of the secondary cataract I only make one incision, but I am careful to study the aspect of the capsulary membrane before I undertake the discission to determine the direction in which the largest number of thickened bands run. If you make the cut diametrically across the bands, a good clear pupil is obtained. These bands do not always run vertically, and it would be ridiculous always to put your knife in at a given point, but study the membrane and make the incision at right angles to its strain and when you cut across once it will be sufficient. A small opening is better than a big one because of the few diffusion circles, and particularly where there exists a coloboma a small opening is best, as these circles are cut off by the membrane remaining above.

DR. W. GORDON M. BYERS, Montreal: I should like to emphasize again very strongly what I said two years ago before this Society, that, altogether apart from the practical advantages of the peripheral route, the benefits of which are readily appreciated by any one who follows it, no other method of needling is justifiable. The great protection

afforded by the conjunctiva against the pyogenic organisms, which are now known to be so frequently present in the conjunctival sac, is a matter of such common knowledge that I feel that a man who nowadays does a discission through the cornea is practising very bad surgery, and doing something that is very wrong and unfair to his patient.

DR. PERCY FRIDENBERG, New York: In regard to Dr. Jackson's suggestion, I would not venture to criticize it without personal experience; but I think a method which in his hands and in private practice may have given satisfaction should be accepted slowly for general adoption. Thus, after making iridectomy and letting the patient rest for a while, there may be some difficulty owing to the patient moving his eye, and this will make the capsulotomy take up more time than it usually does and may lead to complication following the introduction of an instrument like the Graefe knife for a second time. If there were no alternative between this and intracapsular extraction, we might adopt such a method. I want to say a word of the "Norwich" Smith method. I believe that operation has a field of usefulness in selected cases. It rapidly matures a partial cataract—one great point in its favor, especially in those cases where there is involvement of both lenses, the slowly maturing forms in which patients are incapacitated for months and months. Those who have seen the operation done with very superficial and wide separation of the capsule without stirring up the lens matter itself, and by using the excellent knife devised by Smith, which cuts without tearing and does not require to be plunged deep into the lens and has its shank adjusted in such a way that it will nicely stop up the wound and does not allow the aqueous to escape, will be gratified by the rapidity with which, in less than twenty-four hours, the capsule separates from the lens without even objectively visible maturation. Because it is separation of capsule he aims at. The advantage attaching to that method is the one already referred to in reference to the discission of secondary cataract, that you have a preserved anterior chamber and widely dilated pupil and can see exactly where you are working. Now, if we do not wish to adapt this to the forms which are nearly ripe, we still have another method to deal with the mature form, and that is the tear-

ing out of a portion of the capsule with grasping forceps (Fuchs), and it seems to me, from my own experience and that of men whose work I have seen, that with a well-dilated pupil and suitable grasping forceps we are quite sure of getting a large central portion of the capsule actually removed from the eye. Reference has been made to the fact that we cannot depend upon cystotomy openings of the capsule. That is perfectly true. This certainly does not apply to the removal of a portion of the lens capsule with grasping forceps. Where these operations have not been done; where we have secondary membranes, one of the best instruments is a small knife, devised by Woodward, which has the shape of a small harpoon, that is, it cuts in two directions, coming and going. The shaft stops the opening in the limbus and the blade cuts beautifully. I have learned from Dr. Callan to depend very largely on the de Wecker scissors in discission of secondary cataract. In all but the very finest membranes the de Wecker scissors make the cut exactly where you want it and produce no tension or drag whatsoever.

DR. ROBERT L. RANDOLPH, Baltimore: I was very glad to hear what Dr. Jackson said as to the proper point in the cornea at which one should make the entrance into the anterior chamber in the operation of discission. I thought that the habit of making the entrance into the anterior chamber out in the clear cornea had disappeared, but I had occasion to visit a hospital in a neighboring city a year or two ago, and was shown two cases operated upon by different members of the hospital staff, and in both cases the opening in the cornea was quite far from the periphery and there was a little gray area around the point of entrance of the needle. For the very best of reasons, as Dr. Byers has indicated, one would think that the proper place to make the entrance into the anterior chamber in this operation should be in the periphery of the cornea, where we know that the blood supply is good. I hope the Chair will permit Dr. Ziegler to state whether he has ever had any elevation of tension. It would seem that the traction necessary in this operation in some cases would bring on glaucomatous symptoms.

DR. S. LEWIS ZIEGLER, Philadelphia: I can say that I have never had a case of glaucoma following secondary cataract operation, excepting in one traumatic

case about twenty years ago. There should be no traction on the ciliary body if the operation is performed according to the technic I described in my V-shaped operation, because there is absolutely no pressure on the membrane. That is why you have success in this operation. The knife will cut as long as you make a sawing incision without pressure, but as soon as you begin to pull or press backward you have a tearing of the membrane. This point is well illustrated by the Japanese jugglers who walk on swords—they step carefully on the blades and do not cut their feet because the pressure is direct. On the other hand, the slightest drawing of the foot across the edge of the sword will cause a deep wound.

DR. W. E. LAMBERT, New York: In regard to the de Wecker scissors: I have used the Ziegler knife and, before that knife was devised, the attenuated Graefe. I have found them both satisfactory, but I have had a number of cases in which I failed to get results, and had to resort to the de Wecker scissors. The result is that I now practically rely upon the de Wecker scissors in dealing with all secondary cataracts. In regard to Dr. Jackson's incision, I feel that the same result can be better accomplished with a properly constructed cystotome, and I think it is possible that complications might arise in the attempt to do a capsulotomy with the Graefe knife. I have had one experience only in preliminary capsulotomy. The result was particularly satisfactory, notwithstanding a curious complication which delayed the extraction of the lens. It was a case of high myopia in a patient of fifty, in whom one lens had been removed in the usual manner after preliminary iridectomy. The tedious process of absorption of the remaining lens matter tempted me, in the second eye, to do a preliminary capsulotomy, after which I expected to remove the lens within 24 to 48 hours. At the end of forty-eight hours the lens seemed to demand immediate extraction, but as the eye was slightly injected and the microscopic slide showed the presence of diplococci, I decided to wait, and the next day the patient had developed a rather sharp attack of mucopurulent conjunctivitis. The tension had not increased, and the patient was treated with one-twentieth grain of nitrate of silver, carefully watched, and after five days the eye cleared up so that extrac-

tion could be made. The result has proved satisfactory; there was very little soft lens remaining and the patient made a much more rapid recovery with that eye.

DR. SAMUEL D. RISLEY, Philadelphia: I have listened with a great deal of interest not only to the admirable papers of Dr. Jackson and Dr. Sattler, but to the very practical discussion which has followed. In comparing the idea which has been presented for capsule operations with my own personal experience in their use, I must say, and wish to emphasize the fact, that they are largely diagrammatic. To make these incisions and operations on paper and to make them in the cataractous eye is quite a different proposition. In the first place to make an incision through the capsule and later endeavor to join it with another is not always as easy as it seems in a diagrammatic illustration. The first section seems to roll in and give you a firm band to cut through before completing the second incision designed to join the first and thereby completing the diagrammatic figure had in mind. By a steady, persistent, and patient sawing back and forth at this point I am often able to cut it, but by no means always. If the capsule is tough, gray, or one with lines or folds suggesting lines of traction, as Dr. Beard has wisely suggested, the line of traction should be determined, and frequently all that is necessary is to cut the membrane at right angles to the line of traction to secure the needed opening through the capsule. The simpler the operative procedure the better, since it reduces the traumatism to a minimum. When, however, we have the gray, tough capsule, which so often follows the low grades of iritis in rheumatic people and in autotoxic conditions, I believe that the keratome incision in the cornea, followed by the de Wecker scissors, is nine times out of ten a safer and shorter procedure than any attempt to cut the tough but yielding bands of capsule with a knife. The next best, probably the best in certain cases, is the employment of two knife-needles, inserted each at the opposite limbus of the cornea and made to penetrate the membrane at the center and cut or tear the capsule by drawing them in opposite directions. By this procedure one surely gets an opening in the capsule and with less traction upon the adherent iris than with a single knife or needle. I quite agree with those who have in this dis-

cussion pointed out the importance of inserting the knife in the vascular limbus of the cornea.

DR. R. A. REEVE, Toronto: I believe that now, as always, no one operation is suitable for all cases, and, though I admit the great advantages of Dr. Ziegler's needle and his methods, and also that spoken of by Dr. Jackson, I still think that in a small percentage of cases the original Bowman double-needle operation for capsular cataract is the best. It is indicated in cases where, owing to proliferation of the endothelial layer and matting of the sclerosed tissues, a knife, however sharp, will not cut through the membrane without traction on it and the ciliary processes, the very point of danger that we all agree is to be avoided. By the use of the fine Bowman needle made properly sharp you can drill a hole into this membrane without traction, and entering the second needle on the opposite side of the cornea into the same hole one can then dilacerate the membranes sufficiently to get at least a small central pupil. I also believe in a small percentage of cases that iridotomy by de Wecker's scissors is superior to even the Ziegler operation.

DR. PETER A. CALLAN, New York: I did not expect to make any remarks on this interminable subject. We have all our own methods, and I advise those who have a good method to stick to it, not to be changing. In regard to secondary cataracts, I fell very strongly on the subject. Let us ask ourselves the question: Which causes the least irritation? Have you ever lost an eye by the use of the knife-needle in performing secondary cataract operations? By which of the various methods do we have the least reaction? If we take a piece of gold-beater's skin and put it on a drum and then try to make a V-shaped incision, such as recommended, the first is a cut but the second is more or less of a drag. Unquestionably the tension is taken off, and the result is the tearing which we all should avoid. As to secondary membranes: where there is a slight band across the pupillary area, a narrow ground-down Graefe knife will give a satisfactory opening. Taking thick membranes following cataract extraction, there is no method so safe and so sure of giving you an opening and a permanent opening as a de Wecker scissors or some similar scissors. You can

cut every time without any traction, and you make your opening where you please. The corneal opening is best made with a bent keratome, and is only 3 mm. in its greatest diameter. Introduce your scissors and cut in any direction you think best. I have never seen an eye lost from the use of the de Wecker scissors, and I have seen eyes lost from the other method, owing to the traction which is unavoidable, no matter how skilful we are.

DR. SAMUEL THEOBALD, Baltimore: I have always used the Graefe cystotome, making a crucial incision in the capsule in the extraction of cataract; but, for several years, I have been in the habit of passing the cystotome well beyond the lower border of the pupil, securing in this way a very long incision, and then crossing this by a relatively short horizontal one. Since I have been doing this, doubtless because the capsule opens so widely, I have not been troubled by capsular opacity, at all events not from the anterior capsule. I have had to needle some of my cases, of course, but it has been the posterior capsule that called for the needling, and generally months after the operation. The needle-knife I have found most satisfactory is one that belonged to my grandfather, one of the old Hays' needle-knives, more delicately made than those of the present day. At that early period they did not understand the importance of making the shank large enough to prevent the escape of aqueous humor, but by having the shoulder of the blade ground off slightly I have overcome this difficulty. In years gone by it was very generally believed that traction upon the ciliary body was the cause of many of the complications which followed the use of the needle-knife. It would seem, since the Major Smith operation has been introduced, that this belief was not well founded, for nothing could be more severe than the traction on the ciliary body involved in dislocating the lens in the Smith operation.

DR. EDWARD JACKSON, Denver: The opening made in the capsule with the knife which makes the incision of the cornea is an opening that is parallel and directly in contact with the corneal incision. The contents that come out of the capsule come out of the eye. That is one of the chief advantages of that incision. That advantage is not obtained even by Knapp's peripheral cystotomy, because the opening in the

capsule there is not directly parallel, necessarily parallel, and in contact with the opening in the cornea. I want to insist on the point that, although this opening is small, as Dr. Beard correctly says, it must be entirely sufficient to let out the lens without causing any resistance of which you can be conscious. Excepting in the two cases I mentioned of the very thick, tough capsule I was not conscious of any resistance.

When I see diagrams for crucial incisions into the capsule, I always remember that a great many years ago Becker, I think it was, demonstrated to the Heidelberg Congress that after you have made one incision into the capsule you could not make any more incisions with the Graefe cystotome. What you get is usually a series of little tears in the capsule; you do not get any open incision. I believe that the first incision, with the tearing that extends it at its ends, is the thing that lets out the lens in any case of extracapsular extraction. When the capsule is broken and the lens comes out without the capsule, it is the first incision that is the essential one, and the only effective one; and I think that a closer study, which can be made when we are operating on the eyes of the lower animals, will convince any one that that is the case. We cannot study our cataract patients quite in that way. Now the linear incision in the capsule leaves no tags or ends that can possibly get into the wound. It lets everything out of the eye that goes out of the capsule, and prevents that cause of subsequent inflammation. It is the only method of treating the capsule, excepting the intracapsular extraction, that does that.

However skilful your attempts to remove the anterior capsule, you will leave tags of capsule which in almost every case are able to get into some portion of the wound. The remaining posterior capsule and iris, and remnants of anterior capsule, are pushed forward so that they are in contact with the region of the corneal incision. There is the other point in reference to this incision that you can not get any incarceration of capsule in the wound.

Now, in reference to loss of eyes or reaction after needle operation, I would like very much to know if any one in the room has seen the loss of an eye or a serious reaction after the needle operation where the needle was entered fairly

through the vascular tissue. If any one has seen any inflammatory complication after the needle operation, with the needle entered through the vascular part of the limbus, through the conjunctiva and through the overlapping sclera, I would like to have it reported. I remember a case of one of my colleagues at Wills Hospital. He went away at the end of the week after a cataract needling, leaving the case in charge of an assistant, with directions, if anything went wrong, to call me in. I saw the case the day before the patient was to go out of the hospital, and there was a minute speck at the point of entrance of needling. The next day there was a very distinct yellowish point. Within a week the eye was lost by suppuration. Eyes have been lost by needling, there is no question of that,—as much as 2 or 3%,—but it has been invariably, so far as I know, by the now unjustifiable needling through the clear cornea.

DR. ROBERT SATTLER, Cincinnati: I fully indorse Dr. Jackson's statement that intracapsular extraction must be compared with the best method of extraction from the capsule. We cannot, however, accept common experience as our guide for intracapsular extraction, and must rely wholly upon a fair and impartial comparison of the two methods which our own personal experience alone can furnish us. Each operator who has mastered the technical difficulties of intracapsular extraction should compare an equal number of perfect results of one with perfect results of the extracapsular, and the partial successes after the same manner; besides carefully contrasting uncommon complications and accidents belonging to both methods. After all, it is our inequalities as operators and the great variability of our operative material as well which prevent the achievement, through common experience, of more than an approximate uniformity of average success.

Some twelve years ago, having until that time been an enthusiastic follower of simple extraction for a larger proportion of my cataract cases, and fully impressed with its advantages and its greater perfection from a surgical and cosmetic point of view, my doubts concerning its superiority as compared with extraction combined with iridectomy led me to make a more accurate comparison. I could not, of course, question the superiority of the smaller number of

absolutely perfect results, but it did not take me long to determine that the partial successes compared less favorably with the similar ones of extraction combined with iridectomy. On the evidence of my own experience, I abandoned at that time simple extraction with reluctance and regret, and, though often tempted to resume it, the proofs which experience furnished were so convincingly against its justification for even a smaller proportion of my cases that in fairness to patient and myself I have since, with rare exceptions, practised it. In the paper just read a similar comparison of intracapsular and extracapsular methods is given, and as this is fully stated I will refer only to certain remarks of Drs. Callan, Reeves, and others concerning the treatment of secondary cataract. De Wecker's *pince ciseaux* are now rarely used by me for the division of secondary cataract; not that I did not have some excellent results from their use, but compared with the cutting cystotome and knife-needle I have found the latter safer because of the lesser surgical traumatism involved, and because deeper penetration into the vitreous body can be avoided. De Wecker's scissors, however, are preferred by me for the division of the dense, partition-like secondary cataract following sympathetic iridocyclitis.

In the surgical management of secondary cataract I avoid if possible any deeper penetration into the vitreous body. I do not hesitate to open freely, by a linear cutting incision, the thickened opaque anterior capsule and even the hyaloid envelop.

Once the most favorable location for the capsular opening is decided upon, under perfect illumination and magnification, with a cutting cystotome or knife-needle make a linear incision, if possible, triangular or like a small inverted letter Y, and utilize the elastic vitreous body as the wedge to enlarge and maintain the artificial opening made, but under no condition penetrate or plunge the instrument selected for this to any great depth into it.

In some cases in which it appears impracticable to make the inverted Y-shaped or triangular opening with one puncture through the vascular limbus, I add a second at right angles, and have found this most satisfactory, for the reason, again, that surgical traumatism is minimized and all unnecessary traction or penetration is avoided.

Referring once more to Dr. Jackson's point about the danger of post-operative interferences, I have more fully expressed my views in the present paper, and hold that for one and all this is the most treacherous province of ophthalmic surgery. It is our bounden duty to warn those whose experience has not yet afforded them the disappointing disclosures which most of our number have had, that with lesser or greater experience we must approach these cases of secondary cataract with the full understanding of the treacherous character and uncertain outcome of even the most carefully planned and executed justifiable surgical intervention.

MICROSCOPIC FINDINGS IN THE EYEBALL OF A MAN WHO DIED FROM AN UNTOWARD CAUSE SEVEN WEEKS AFTER THE EXTRACTION OF A SENILE CATARACT.

W. GORDON M. BYERS, M.D.,
Montreal, Canada.

E. N., aged seventy, consulted me at the Royal Victoria Hospital on July 25, 1906, for failure of vision in both eyes. Examination showed that the patient had a senile cataract on both sides. V = R. E., $\frac{6}{60}$; L. E., fingers at eight feet. As there were no contra-indications, and the patient was anxious to regain his sight (as glasses had failed him and he was no longer able to do his work), I decided to operate, counting on a dense lenticular nucleus as the result of his advanced years, and irrigation to remove any lens substance that might remain because of the somewhat immature condition of his cataracts.

On July 26 I operated on the more affected left eye. The extraction, done with an iridectomy, was unattended by any difficulty, save only that, as I had anticipated, the lens was slightly sticky. The eye quieted rapidly, and was so far advanced in healing that I extracted the right lens on August

6, eleven days later. Here, too, no difficulties were experienced, and there was no trouble with soft cortex. The course of the case was normal in every respect, and the eyes looked well when the patient was discharged for treatment at home on August 18.

On September 14 the patient was readmitted to the hospital. There was still slight injection on both sides; but I put this down to imperfect treatment at home, where he said conditions were not right for his being properly looked after. I had him admitted solely that he might be better cared for. There was a good deal of capsule and lens substance in both pupils, but not more than I had seen and successfully dealt with on previous occasions. He counted fingers with each eye at two feet. There was nothing abnormal noted in connection with the patient on readmission or during his stay in the hospital, but early on the morning of September 26, after having talked cheerfully and rationally the previous evening with his room-mate, the man jumped from the high ward window and was found dead when reached by the orderly a few minutes later. The left eye was quiet at the time of the accident, but the right globe was still slightly congested and was enucleated for microscopic examination.

Microscopic Examination.—Sections (collodion, and hematoxylon and eosin) made through the site of the corneal wound and the coloboma of the iris show a very marked round-cell infiltration of the subconjunctival tissue, extending to the very end of the piece of conjunctiva removed with the globe, and of the episcleral tissue, as far back as the insertion of the rectus muscle. Fusing at the limbus, these two zones of inflammation become more and more separated posteriorly by connective tissue free from change.

In the substance of the cornea (Fig. 1), well within the corneoscleral junction, one sees the corneal incision with its outer entrance filled by a quadrilateral mass of epithelial cells in direct continuity with those of the cornea, which

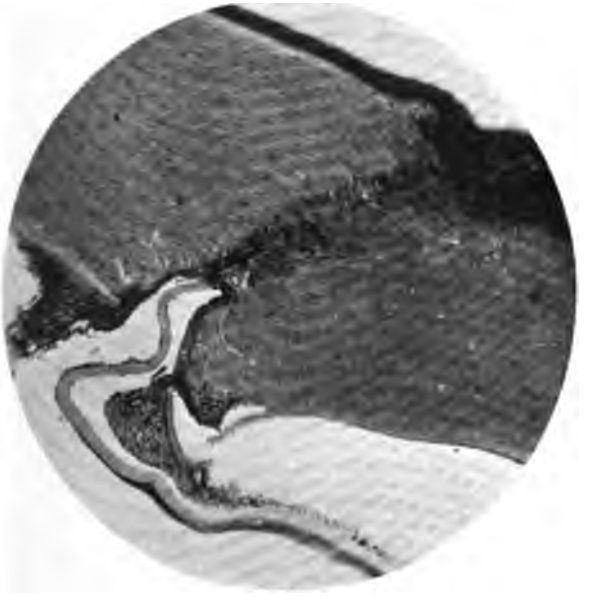


Fig. 1.—Microphotograph showing the corneal wound at the site of the entanglement of the tag of anterior lens capsule.

otherwise show no change. Immediately below this, for about four-fifths of its thickness, the substantia propria is firmly united by newly formed connective tissue, which, perhaps, suggests the appearance of being in an edematous condition. Posteriorly, however, the incision gapes widely, forming a large triangular aperture in the center of which is a large tag of the anterior capsule of the lens that is not seen in any of the other sections from this specimen. On both sides of the wound the margins are covered by large masses of cells, coming from the endothelial layer to take part in the process of repair. Elsewhere on Descemet's membrane there are no signs of cyclitic dots. The spaces of Fontana and Schlemm's canal are filled with leucocytes, which are also seen in considerable numbers lying in fibrinous exudation in the angles of the anterior chamber.

The substance of the iris is only slightly infiltrated, but there are a considerable number of cells and a certain amount of fibrinous exudation along its anterior surface. The inflammatory changes are less marked near the site of the coloboma than they are in the lowest part of the pupil, where the tip of the iris is densely infiltrated and adherent to the anterior capsule of the lens by an organizing mass of cells in which one sees a considerable number of the plasma type.

The ciliary bodies are slightly, if at all, involved, and the remaining structures of the eye appear to be quite free from change. One sees only a few cells of the usual type in the meshes of the zonular ligament.

The collapsed capsule of the lens is filled above and below and in its middle part by a certain amount of lens substance. The mass in the pupillary area is densely invaded by leucocytes, which appear within and between the lens fibers.

I thought the members of the Society would be interested in seeing this specimen because it illustrates very beautifully a number of different points. First, the reparative changes, though extremely well known, are clearly demonstrated in the sections. Then, the finding of the entanglement of lens capsule is not common, and is interesting in the light of the complications which may arise from this source. The cellular infiltration in and about Schlemm's canal throws light upon the way in which exudates are absorbed from the ante-

rior chamber; and the obvious "scavenging" changes going on in the lens are illuminating, especially to those who have been in the habit of explaining the absorption of lenticular substance by purely physical processes. Finally, one sees that the iritis, a mild one, is merely a local reaction to injury, and that there are no perivascular foci of infiltration in the iris and ciliary body, such as one finds in inflammations of these structures of systemic origin.

THE OPERATION OF COMBINED IRIDECTOMY AND SCLERECTOMY FOR CHRONIC GLAUCOMA.

E. GRUENING, M.D.,
New York.

In the "Archives d'Ophtalmologie" for 1906 and in the "Ophthalmoscope" for 1907 Lagrange described and illustrated the combined operation mentioned in the title. This method of operation seems to have been eagerly adopted in America. The most recent American text-books on ophthalmology, those of de Schweinitz, Weeks, and Fuchs, in the American edition, describe the operation and reproduce Lagrange's illustrations. In German literature, on the other hand, the combined operation does not seem to have won favor, and in the latest edition of Czermak's Ophthalmic Operations, brought out by Elschnig, the latter says: "This procedure will appear desirable to those operators who wish to obtain a badly closing cystoid scar." To the above remark I would take exception. In my experience, if the operation is properly performed with a well applying conjunctival flap the wound closes in a short time, the anterior chamber is restored, and the intraocular tension

is more permanently reduced by filtration in the combined operation than in the simple iridectomy. I wish, however, to draw attention to the fact that Lagrange's illustrations in his own articles and in the American reproductions do not exactly show what he wishes to convey to his readers. The scleral wound there and in all American reproductions measures 12 mm. If, in a given case of glaucoma with a tension of from 45 to 55 mm. of quicksilver, we would practise so large an opening we would invite prolapse of vitreous, which, as a matter of course, is to be avoided.

The question may be asked what my experience has been. In the past two years I have performed this operation 21 times. In this group of cases the youngest patient was twenty-three years of age, the oldest eighty-two. The tonometric measurement by the Schiötz apparatus was made in each case before the operation and at a suitable period after it. The cases varied as regards the intraocular tension from 35 to 55 mm. of mercury, and that tension was not reducible by the use of miotics. As far as the limited time that has elapsed since the operation permits me to judge, the tension was permanently reduced in each case with decided improvement of vision in the majority.

In the case of a man of eighty-two whose eye was blind and painful, the distressing symptom of pain disappeared, and, though the conjunctival flap adhered, the anterior chamber had not been restored five weeks after operation. The eye, however, was soft and gave no discomfort.

I may make mention here of another case, that of a young man of twenty-six years of age, upon whom I operated on both eyes in 1910 by a simple iridectomy. He had lost the central vision of the right eye, with which he could only count fingers eccentrically. The left eye had concentric limitation of the visual field, and vision $= \frac{2}{40}$. The wound in the right eye healed with a filtering scar. The wound of the left eye with a firm cicatrix. The right eye improved,

central vision was restored in spite of a deep cupping of the optic nerve, and the eye remained soft. The better eye, the left, the scleral wound of which had healed firmly, became hard again. Tension rose to 55 mm. and could not be reduced by miotics. Vision was reduced from $\frac{20}{40}$ to $\frac{20}{200}$. The eye seemed doomed. As a broad iridectomy had been previously made upward I practised the combined operation downward and obtained a filtering scar. The eye remained soft until this day, and vision improved to $\frac{20}{70}$.

My technic differs somewhat from that described by Lagrange. The knife is entered one mm. above the limbus of the cornea, at a distance of 3½ mm. from the vertical meridian on one side, and is brought out at the same distance from the vertical meridian on the other side, so that the scleral wound measures seven mm. The sclera is not cut at a slant, but at right angles. When the sclera has been cut, the knife is inclined and as large a conjunctival flap as possible is detached. The conjunctiva is then lifted with forceps, and with a few strokes of the scissors its adhesions to the lower scleral flap are separated. If the iris prolapses, which it generally does, it is excised as a first step. The edge of the lower scleral wound is then seized with delicate forceps and a piece of the sclera about one mm. in height and two mm. in length is cut out. The conjunctiva is then carefully replaced. If the iris does not prolapse, the sclerectomy is practised first and iridectomy as the second step. The gap in the sclera remains open in the great majority of cases. In two of my cases the site of the scleral excision was only indicated by a black line. In a small number of cases there remained at a later day no evidence of the excision of the sclera. Of the cases described, 11 occurred in my private practice and could be carefully watched.

I must also mention that I performed the operation in the larger number of cases under general anesthesia. The operation is more difficult than the simple iridectomy, and if we

can eliminate the resistance of the patient we improve the chances of success.

As we do not know the cause of glaucoma, and can, therefore, neither adopt a rational nor an empirical prophylactic treatment, we must limit ourselves to the re-establishment of the equilibrium in the secretion and excretion of the intraocular fluids. We cannot regulate the secretion, which may depend upon conditions too subtle for our inherent limitations, but it seems that we can proportionate the excretion, for this the Lagrange operation does in many cases.

In conclusion, I would then say that the combined operation of iridectomy and sclerectomy in chronic glaucoma, if performed with the utmost care and under a general anesthetic, is preferable to simple iridectomy for the following reasons:

1. The wound heals more rapidly because of protection afforded the field of operation by the conjunctival flap.

2. The anterior chamber is speedily restored.

3. The patient need not maintain the recumbent position for so long a time.

4. And, finally, the results obtained in my series of cases as to the function of the eye were sufficiently favorable.

Of course, a longer time of observation and a larger series of cases are required for more certain conclusions as to the value of the Lagrange operation.

DISCUSSION.

DR. ROBERT SATTLER, Cincinnati: We are all indebted to Dr. Gruening for sounding the note of warning. Lagrange's operation is not an easy one, and the making of an initial section, as described, necessarily adds new and grave dangers. My experience has been limited, but I appreciate what Dr. Gruening has stated, and know it will be of advantage in our choice and justification of this operation for the uncommon cases of glaucoma in which it may be indicated.

DR. R. A. REEVE, Toronto: There is an alternative operation which, in my experience, is as simple, or indeed simpler, and is as effective, that is, trephining, the modifi-

cation by Elliott, of Madras, where you dissect up a conjunctival flap down to the sclera and right into the limbus, the disc removed being partly corneal. Excision or incision of the iris is not an essential feature.

DR. E. E. HOLT, Portland: At first the Elliott operation was performed as described by him, and illustrated here on the board by Dr. Reeve. In some cases it was necessary on account of the returning tension to lift the flap to get better drainage and reduce the tension. Acting on a suggestion made by Dr. Fox of cutting the conjunctiva off at the margin of the cornea and making the flap so as to swing it from left to right, the flap could be lifted up much easier, the drainage controlled, and the tension of the eyeball reduced more readily than when the flap was made as described by Elliott.

DR. S. LEWIS ZIEGLER, Philadelphia: I think that the point that Dr. Gruening has raised in regard to the size of the incision is very important, because the illustrations of Lagrange are exaggerated beyond reason. The advantage which we want to gain from Lagrange's operation is a filtering cicatrix, but the disadvantage of the marked filtering cicatrix is a cystoid conjunctival elevation under the lid. The more successful you are with the operation, the more pronounced you have this slight elevation. I do not think that the Lagrange operation is so difficult to perform. I have not used Lagrange's curved scissors, but I have excised the sclera with shallower curved scissors and made two incisions, one on each side of the scleral flap, the incisions meeting in a V in the middle. So far as comparisons are concerned, I think that the Elliott operation is slightly more dangerous, because of the trephining. I believe, however, that I prefer the Herbert operation, in which you make subscleral incisions on both sides of the sclerocorneal wound, with a small curved knife introduced through this wound, and cut out through the angle, thereby undermining the conjunctiva. I think the results have proved to be the best of the three operations.

DR. W. E. LAMBERT, New York: I find the operation described by Dr. Gruening very satisfactory. I have used instead of scissors, however, a Stevenson punch. It better gages the amount of sclera removed and simplifies the operation.

A PIECE OF GLASS IN THE CRYSTALLINE LENS, WITH DESCRIPTION OF THE EYE THREE YEARS AND A HALF AFTER THE ACCIDENT.

J. HERBERT CLAIBORNE, M.D.,
New York.

During the morning of November 28, 1908, a youth of sixteen years, while sitting at a table, was engaged in filling a two-ounce vial with the explosive caps taken from large paper torpedoes. He had filled the vial almost completely, and was pushing the last one in with a small stick, when he used a little more force than before; suddenly there was an explosion. He had the vial clasped in his left hand and held it just a little to the left of the median line of his face. He was thrown from his chair to the floor by the explosion and into a condition of partial insensibility for a few moments. When he was picked up, his left hand was found to be badly lacerated and his right slightly; particles of glass were driven into the flesh. It was also observed that there was a cut on the right side of the bridge of his nose not quite to the bone, about a quarter of an inch in length, and that his right eye was slightly bloody. As soon as he was able to take note of his surroundings he discovered that the vision of his right eye was blurred. Dr. Walter Gilday, of New York City, took charge of the patient's hands and he requested that I treat the eye. I saw the patient about 2 P. M. The lids were not injured in any respect, but there was a slight edema of the ciliary border of the right upper lid. On pulling the lids apart, I found the eyeball pink; there was a cut in the sclera about 2 to 3 mm. from the scleral margin, about 4 to 5 mm. in length, and slightly crescentic. The wound appeared to be made by a foreign body which had come from above and slightly inward. I judged this from the fact that the wound gaped in that direction, and that the anterior lip seemed to overlap the posterior one. There was no iridodialysis. I was

unable to examine the interior of the eye at that time on account of the hemorrhage.

I decided my duty was to have an *x*-ray picture taken immediately, and determine the existence or non-existence of the foreign body in the eye, and laid the matter strongly before the mother. Her nervous system, however, had been so completely shattered by the accident that she refused to permit the boy to be taken out of the house in his then condition. I explained the immediate necessity of removing the prolapsed iris, to which she acceded, and that was done the same afternoon under general anesthesia at his home. The prolapsed iris was neatly excised, and I afterward thrust the forceps well into the lips of the wound in every direction in the hope of finding the piece of glass, but without success. I could not, however, bring myself to grope blindly into the vitreous humor and so desisted from further effort for fear of doing more injury. A few drops of a 1% solution of atropin were instilled into the eye and a bandage applied. There was no subsequent pain, and in about forty-eight hours the blood had cleared to such an extent from the anterior chamber that I was able to see that the lens was not dislocated, but that there was a dark smudge in the region of the wound in the vitreous behind the lens. The eye remained quiet for about a week, when a punctate inflammation appeared on the cornea which quickly proved itself to be a beginning mycotic keratitis. This was treated with the actual cautery and was stopped at once. Within a week several other points appeared in another region of the cornea and they likewise were immediately destroyed. After these there were no more. The corneal lip of the wound now commenced to get very gray and to buckle, and I began to feel certain that a foreign body was in the eye. I used argyrol, and finally the wound commenced to close; the corneal lip, however, remaining dirty gray. On January 5 the eye,

having become quite white and the wound closed though still gray, I had an *x*-ray made by Dr. George Dixon, the chart of which is shown in Fig. 1. The position of the foreign body appeared to be to the rear and inner side of the lens. A short time after the *x*-ray picture was taken the eye became still quieter and I examined it with the ophthalmoscope and oblique illumination. While I could still see the dark smudge already referred to, it appeared to me that a foreign body was piercing the lens. The eye, however, re-

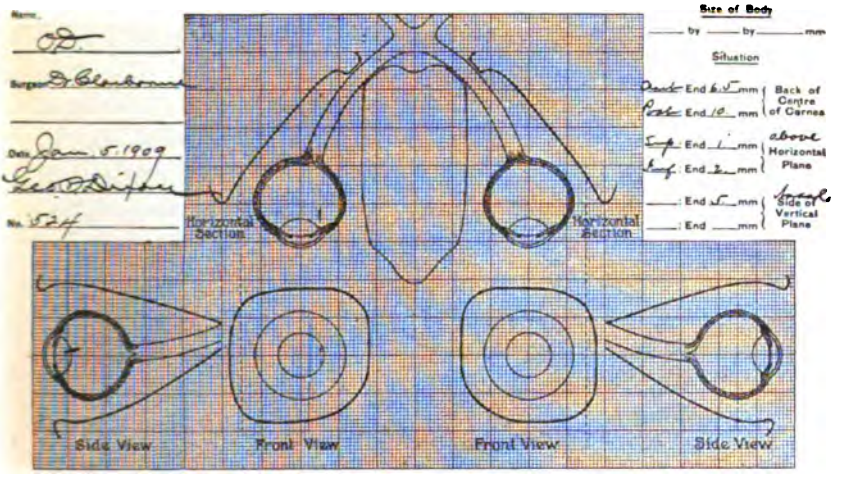


Fig. 1.—*X*-ray localization chart of a piece of glass in the eye; one-half size.

mained quiet without any irritation, and finally, in February, I allowed the patient to go to school, but directed him not to use his eye for near work. On January 1, 1909, his vision, with correction, was $\frac{20}{40}$ minus; on February 23, $\frac{20}{40}$; on March 11, $\frac{20}{40}$ plus; and on April 7, it was $\frac{20}{30}$. On April 23, 1912, 3½ years afterward, V = $\frac{20}{40}$, with correction. He was injured in November, 1908; the following October, 1909, about eleven months afterward, he went regularly to school and has been using his eyes constantly since that time without any trouble.

Present Condition.—There is a scar on the inner side of the right cornea, slightly upward and inward, about 5 mm. in length, and 2 to 3 mm. in width, extending over into the sclera, more or less crescentic in shape. A small clean iridectomy inclines slightly upward and inward, pear-shaped, with the stem toward the periphery, with the columns of the coloboma practically in the same place. A grayish opacity of the lens, broad at the base and extending from the periphery outward and slightly forward, comes to a rounded point just short of the vertical meridian and a trifle above the horizontal. The rounded point is encircled by a number of small points of opacifications resembling very much a swarm of small insects. A few of these points likewise are between the base of the opacity and the end along the shaft of the projection. The opacity moves slightly against the movements of the eye, showing that it is more or less posterior to the equator of the lens.

It seems highly probable that the projection referred to is the piece of glass, and that the smudge at the periphery is caused by the changes made by the wound. There is no trace left on the cornea where the cautery was used. Looked at by transmitted light, of course, the opacities are dark, and the projecting shaft is darker than the rest; the base allows the reflex from the fundus to pass through at several points, while the haze around the head of the shaft appears very faint—this is possibly the explanation of the good vision. A reflex can be distinctly seen at the extreme periphery, linear in character, probably through the ligament of Zinn. It is likely that that structure is transparent, and this would be more or less consistent with the position of the wound in the sclera and the direction of the foreign body. The fundus of the eye is normal in every other respect, and while the pupil is pear-shaped, as stated, it is exceedingly small, and can scarcely be detected except on careful scrutiny.

It appears that there are a number of points of interest in

connection with this case. First, the character of the accident. I have not been able to find any record of a similar case, though I have known one in which a steam gage exploded and blew particles of glass into the eye without their having penetrated the interior. The caps contained in the torpedoes were inclosed in paper, and had considerable explosive force, and, when we reflect that the two-ounce vial was filled with these and all exploded at once, we recognize that the force of the explosion must have been considerable. This fact is demonstrated by the terrific laceration of his left hand and the depth to which the glass was blown beneath the surface of the skin. The majority of the pieces of glass were rather small, which is likewise evidence of the force of the explosion. In regard to the piece of glass which entered the eye its size was estimated to some extent by Dr. Dixon; its length can be judged from the measurements between its two ends. The fact that the foreign body had not passed very far back into the eye, the fact that the position of the wound was slightly upward and inward, and that the length of the wound measured about the same as that of the foreign body convince me that it entered the eye sideways on the rebound after it had struck the side of the nose, and that, after having entered, one of its ends turned and pierced the lens in a direction slightly forward and outward. It is impossible for it to have entered the eye directly, since the wound looked upward and inward and its anterior and lower lip overlapped and dovetailed the upper and posterior one. In addition, if it had entered directly, the force of the explosion must have driven it into the depth of the eye.

The patient was fortunate and unfortunate; it was not as bad as it might have been. As a matter of course, there was grave necessity for making an *x*-ray picture at once to determine the position of the foreign body, if it existed in the eye. If, however, this had been done, a certain amount of time would have been lost, and the condition,

as estimated by Dr. Dixon, might have induced me to make bolder attempts at removing it. This would certainly have failed, in view of its position as now known. To have attempted to remove it after its position had been plotted would, in my opinion, have been bad surgery, as about six weeks had elapsed since the injury. It is fortunate that the mother refused to have the examination made, but the successful outcome of this particular case does not invalidate the advisability of immediate *x*-ray examination after foreign bodies have entered the eye, of whatever nature they may be.

The foreign bodies which enter into the interior of the eye are, as well known, steel and iron, stone, wood, glass, copper, brass, coal, and small shot. Steel and iron are by far the most common; and since the introduction of the *x*-ray into surgery the management of these cases has been much simplified and many eyes saved which would have been hopelessly lost. The creation of the great magnet of Haab and other magnets has rendered removal of these magnetic bodies possible, and has created an epoch in the surgery of the eye. Other foreign bodies, if they are to be removed from the interior of the eye, must be first located by *x*-ray and removed by groping more or less blindly with forceps. In rare cases some have been located by the ophthalmoscope, and removed through an incision in the sclera. I have known this done in the case of cysticercus in the vitreous. Since the introduction of breech-loading firearms we have ceased to meet with cases of copper in the interior of the eye except in rare cases. Perhaps one explanation of the fact that non-magnetic bodies—for example, stone, glass, coal, and wood—remain in the anterior part of the eye is the fact that such bodies are rarely thrown into the eye with great force. Accidents in which glass enters the eye are generally caused by fracture of eye-glasses, from a blow from some hard substance, such as a ball or stick. I have known of several such cases which, however, were not in my prac-

tice. I believe that accidents from brass are exceedingly infrequent.

I have known of one case in which a bird-shot entered the eye beyond the ciliary region and remained apparently encysted in the fundus for fifteen years without producing any active inflammation. The patient's eye was always sensitive to light and use, and he was compelled to wear dark glasses in daylight. He has since passed from under my observation, but I examined his eye for fifteen years from time to time.

It would appear from this case and others that shot became encysted and gave little trouble. It is worthy of remark also that in this case there was no other change whatever in the eye.

The general opinion exists that injuries from copper have a bad prognosis. There seems to be little doubt that certain chemical changes are produced in the tissue of the eye by the residence of copper, and Leber has attempted to show that this metal is apt to cause suppuration even without the introduction of pus-forming bacteria, if the metal is located in the vascular portions of the eye; when in the non-vascular portion it is borne well. A number of authorities agree that copper is borne well in the anterior part of the eye. In general it may be said that glass, stone, coal, and wood do not produce chemical changes. Laying aside the question of chemical change, it may be said, in general, that the toleration of foreign bodies in the eye depends upon whether they carry infectious germs with them in their entrance. It would seem that stone, glass, coal, and wood are most likely to carry infectious germs since they rarely enter in a condition of heat.

Fuchs maintains the prognosis must be stated to be absolutely unfavorable when the foreign body has been left in the eye.

The position of entrance is not considered to be a matter

of such great importance now as in former times, and I think the general impression exists to-day that the ciliary region has not so many terrors for us as it formerly had. Certainly a sterile foreign body or sterile knife may be passed through the ciliary region without producing iridocyclitis. Nevertheless, the prognosis in general is better in those cases in which the ciliary region is not the point of entrance. In the case which I have just described the glass passed through the ciliary region and it must have been very hot from the explosion; yet it touched the skin in all probability before it entered. If this were true, it probably remained hot enough not to be infected, as no intraocular infection occurred afterward. The infection of the cornea and lips of the wound which occurred a week after the accident I believe was due to other causes, as the patient remained in a room heavily upholstered. I believe the grayness of the lips of the wound was caused by the same microbe which infected the cornea.

The prognosis when foreign bodies remain in the lens is better than when they remain in other parts of the eye, and the same necessity for immediate operation does not exist; but foreign bodies in the lens, as a rule, in time produce complete cataract, and in several instances have been removed later along with the lens.

Doyne has reported a case of foreign body in the lens which entered the eye in childhood and remained for thirty years. Later the patient served in the English army and was a good shot.

Lewis has reported a case of steel in the lens which remained for six years with normal vision.

Bruner has reported a case of removal of a piece of steel from the lens by magnet without an increase in the opacity.

Knapp removed a piece of steel from the lens by magnet, though the eye was lost finally by panophthalmitis.

The numerous points of opacifications around the shaft

and head of the foreign body in my case have appeared since I last saw him, two years ago, and I believe is the forerunner of a complete cataract. It is interesting, however, to observe that his sight remains the same under correction, and that he has been able to use his accommodation for near work without any discomfort. This fact also favors the view originally held by me that the foreign body had not injured the ligament of Zinn.

The points of interest in this case may be summed up shortly: A youth of sixteen received a wound in the eyeball through an explosion; a small spicule of glass, about 3 to 4 mm. in length, entered through the ciliary region apparently just to the rear of the ligament of Zinn; the iris was prolapsed and the prolapse was cut off. The eye became quiet at the end of about a month; after twelve months of rest the patient commenced to use his eyes at school in the ordinary way, and throughout the whole length of time the vision ranged, under correction, between $\frac{20}{30}$ and $\frac{20}{40}$; the latter being the vision at this date. The eye is scarcely deformed at all; pupil is black, coloboma visible only under close inspection, and the patient has used his eye without any discomfort for two and a half years.

Slight increase in opacification of the lens has occurred. The question arises: what is the future of that eye? I believe ultimate complete opacification of the lens.

DISCUSSION.

DR. SAMUEL THEOBALD, Baltimore: A case somewhat similar to this occurred in my practice about (I am sorry to admit it) forty years ago. A young man was making a chemical experiment with a test-tube. The tube exploded, and a spicule of glass passed into the anterior chamber and was seen hanging by a bit of membrane from the upper margin of the pupil. While he was in my office it dropped out of sight, falling behind the iris. Considerable reaction followed, the eye became red and sensitive to light, but after

a short time the inflammation subsided. The bit of glass fortunately was sterile, and it doubtless became encysted. From that day to this it has given him no further trouble, and he knows no difference between the two eyes.

DR. S. LEWIS ZIEGLER, Philadelphia: I had a case somewhat similar to this from the explosion of an electric lamp globe, in which a small spicule passed into the lens and ultimately, from its sharpness, produced opacification of the lens. I think that will probably occur in this case because of the sharpness of the glass. I recall a case of a lady whose spectacle lens was broken by some boys throwing stones in the park. The small spicule passed into the eye and could be seen in the fundus. It was not removed because vision was so good that she declined operation. It would have been very difficult to operate because of inability to see the small foreign body in the vitreous after the incision had been made. About a year later this small spicule passed out through the sclera and was imbedded in the muscle below, causing an insufficiency of the muscle amounting to 30 or 35 degrees. Eventually it appeared externally and was removed. Like small needles in the body, a spicule of glass is liable to travel.

DR. W. E. LAMBERT, New York: I had an opportunity of seeing this case before the *x*-ray was taken. Although it was very difficult to demonstrate the presence of a foreign body, it is my impression that I felt sufficiently convinced of it to advise an attempt to remove it. I was probably emboldened in suggesting this by a fortunate experience I had had. The patient was a myope wearing glasses, and while playing tennis one glass was struck with the racquet and quite a large piece perforated the cornea and imbedded itself in the lens. I believe I have reported this case to this Society. I saw him within two hours of the accident and the presence of the glass was clearly demonstrated. The next day Dr. Bull, in consultation, was inclined to leave it until the lens became sufficiently opaque to justify the extraction of the lens itself. We waited for a few days and the patient developed rather alarming symptoms, swelling of the lens and considerably increased tension and pain. Dr. Bull advised waiting, while I desired to operate at once. The result was that we made an effort to remove the glass. An

incision was made in the periphery of the cornea with a large keratome and the lens substance evacuated. The glass did not come out with the lens, and it was very difficult to locate it as it could not be seen through the clear pupil. However, I introduced a wire loop and got the glass. The result was very satisfactory, and he now has $\frac{20}{20}$ vision.

I recall another case of foreign body in the lens which ended disastrously. The man, a missionary from Rio de Janeiro, came to New York with a history of injury to the eye, and some attempt to remove the foreign body. An *x*-ray by Dr. Dixon demonstrated the presence of a small foreign body in the lens. At the time I saw him the lens was completely opaque. We made an incision and did a capsulotomy, and removed the lens and the foreign body. The man did well for a few days, but on the fourth day he showed symptoms of a low-grade cyclitis, and the eye finally had to be enucleated.

DR. WILLIAM M. SWEET, Philadelphia: In 1905 I reported the history of an injury to the eye by a particle of glass from an exploded lubricating gage. I first saw the patient, a locomotive engineer, six months after the injury, at which time the cornea showed a linear scar. A smaller scar could be seen in the iris immediately back of the corneal injury. The lens was absorbed. No view of the fundus could be obtained, owing to the haze of the vitreous. Several radiographs were made, and a faint shadow secured on the plates of a foreign body which was localized close to the ciliary body, at its lower temporal portion. Under ether an iridectomy was made through an incision at the lower outer corneoscleral junction, and a pair of forceps passed to the spot indicated by the radiographs. After several unsuccessful attempts, a mass of exudate was withdrawn, in which was found a particle of glass, 4 x 2 mm. Little reaction followed the operation, and the eyeball was saved.

I have always regarded wounds of the eyeball from glass as serious forms of injury. It is not always possible to give a positive diagnosis by means of the Roentgen rays, as the particles of glass may be too small or too thin to cast a shadow that can be differentiated from the denser shadows made by the orbital bones. Even though the *x*-rays may

show a piece of glass in the eye, there may be smaller spicules that are not shadowed on the plate.

DR. C. H. BEARD, Chicago: Probably some of the members recall a case of glass in the eye that I published some years ago, I think in Knapp's Archives, that gave me a suggestion in regard to the handling of a bit of glass or foreign body of any kind when in the posterior chamber. It is well known that a foreign body is not tolerated in the posterior chamber anything like as well as it is in the anterior chamber. The patient was a chemist for the Standard Oil Co. In experimenting with certain gases in a glass retort it exploded and one piece went into the eye. There was a wound in the cornea and just a tiny speck on the anterior capsule. It was quite evident that the foreign body had not penetrated the anterior capsule. There was no shadow to the *x*-ray. The eye would flare up with a tremendous attack of inflammation and then subside. I put him in the hospital twice. Finally, the eye quieted down so that I ventured to send him home. The very first night he was home he went down into the basement to examine his furnace, and in order to see into the grate-bars of the furnace he almost stood on his head, when he felt something in his eye. It was very evident something had occurred there. He came back to me and there, in the anterior chamber, was the glass as plain as could be. The explanation of it was that in getting down in that position the glass slipped over the posterior surface of the iris and fell into the anterior chamber. To put the patient's head downward would certainly be one way to cause the foreign body to pass into the anterior chamber, where it could be better dealt with.

DR. J. H. CLAIBORNE, New York: The main point that interested me in the discussion was the question of migration. It has been shown that foreign bodies in the interior of the eye are apt to migrate, but this foreign body has evidently become stuck in the substance of the lens and I doubt if it will ever move. The point upon which I wished more particularly an expression of opinion is the prognosis of the case, the future of the eye. The fact that within the last twelve months a swarm of opaque small points has occurred around the shaft and the end of the foreign body leads me to think that the lens will become totally opaque and will have to be removed.

REPORT OF SIX CASES OF DEGENERATION OF THE CORNEA IN THE SAME FAMILY (NODULAR KERATITIS).

DUNBAR ROY, M.D.,
Atlanta, Georgia.

These cases are reported because of their rarity, if we may judge from the literature on the subject and the number recorded by American ophthalmologists.

At a previous meeting of this Society Dr. Kipp presented the history of a case which he called "grill-like keratitis," and with the exception of the case reported by Dr. Veasey under the title of "Family Macular Degeneration of the Cornea," I can find no other mention of this subject in the Transactions of the Society.

Such cases can be presented only as curiosities, for their pathology is still veiled in obscurity, and each observer has been allowed to hold to his own etiology. However, we are compelled to recognize the family type of the disease no matter what names are used in describing the affection, whether it be macular, nodular, grill-like, fenestrated, latticed, trellised, or even family degeneration of the cornea.

In the literature at my command the greatest number of cases reported as occurring in the same family was three, and these have been published by A. McNab and Fehr.

My own cases consisted of a mother and five children, all of whom presented the same clinical symptoms, differing only in degree according to ages, being more pronounced in the mother and barely perceptible in the youngest child.

CASE 1.—Mrs. F. R. H., white, aged forty-eight, consulted me Sept. 18, 1907, on account of some dimness of vision and

a desire to obtain glasses for its correction and for the better use of her eyes for sewing and reading.

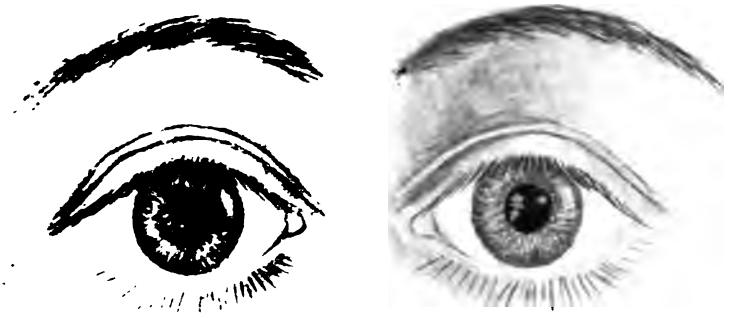
Family and Personal History.—Her husband disappeared several years ago. At that time he was enjoying the best of health. His eyes apparently were in good condition. Mrs. H. has always been healthy, never having had any inflammatory disease of her eyes.

Is the mother of five children, all of whom are living and in good health.

Present History.—Has had weak eyes all her life, and the vision grows dimmer with increasing years. She has no pain in the eyes, but is unable to do close work, although she has had numerous glasses prescribed without benefit.

Examination.—Right Eye: No signs of inflammation or congestion. V. R. E., = $\frac{20}{70}$; L. E., = $\frac{20}{50}$. Retinoscopy shows hyperopia of plus 3 D. in both eyes. However, no correction improves the vision. Fundus was seen to be normal, but deposits were found in the cornea. With a corneal loupe these were examined under a strong light.

At the center of the cornea and gradually fading toward the periphery could be seen numerous small opaque dots of various sizes and shapes. Some were round, others square and rectangular. At the center of the cornea they were very close together, and toward the periphery the clear cornea was more in evidence. The appearance was more as if the surface had been coated with small particles of meal bran. They seemed to project slightly above the surface; their periphery was bordered by a whiter line of demarcation. The color was of a dirty gray. After cocainizing the cornea one could lift the edges of these spots with a very fine spatula; but it was with great difficulty that the whole opaque particle could be removed, and even then the surface left was indented and opaque. It was more like a mycotic condition. This manipulation even under cocain was somewhat painful. One or two of the scrapings were given to the pathologist, who reported the finding of no micro-organisms either under the microscope or by cultures. The specimen showed more of a hyaline degeneration, which agrees with Groenouw's observations. In this patient there was absolutely no family history of tuberculosis, nor was there



Miss H.—Age twenty.

Mr. Guy H.—Age twenty-seven.

Mrs. F. R. H.—Age forty-eight.
Degeneration of the cornea.

the slightest indication of the same in the patient herself. All of her children give the best indications of good health.

Treatment.—Every known local and systemic remedy was tried which experience taught offered the slightest prospects of benefit, such as atropin, dionin, yellow salve, calomel powder, cautery, etc.

Finally we undertook to remove the spots by curetment. This was done at intervals of a week or ten days, scraping away not more than three at a sitting, because of the pain, even under deep local anesthesia. There was always quite a little reaction, which had to be combated by atropin, hot fomentations, and exclusion of light. Only the superficial parts of the opacities could be removed, as the deeper portions seemed to be in the superficial layers of the cornea proper. This treatment was continued for several months, and then abandoned, as it appeared to me that no permanent results were being obtained. A year later the patient claimed that her eyes had been more comfortable than ever before, although there was no material change in her vision.

May 23, 1909. Both corneas appeared practically the same as when last seen.

V. = R. E., $\frac{20}{100}$; L. E., $\frac{20}{50}$. Improved by no glass.

March 23, 1912, V. = R. E., $\frac{20}{100}$; L. E., $\frac{20}{40}$.

CASE 2.—Roy H., aged twenty-nine. Lives in Mississippi. Mother says he has very weak eyes and that his vision is quite defective. She is sure he has the same spots on his eyes as her own. He was unable to be seen, and therefore no examination made.

CASE 3.—G. E. H., aged twenty-seven. Patient has always suffered with weak eyes. When about ten years of age they were operated upon for internal strabismus. At present he has external strabismus, the left being constantly deviated. Is hyperopic, and wears glasses of plus 1.50 D.

Examination.—Both corneas show much the same appearance as found in his mother, with the exception that the corneal spots are very few, and just at the center. They are of the same appearance in every particular.

They have not changed during the last two years. Patient is strong and robust looking, and has never been sick.

CASE 4.—Mrs. S. M. G. Married daughter, aged twenty-five, lives in Washington, D. C. First seen in 1905. Examination made for weak eyes.

V. = R. E., $\frac{20}{40}$; L. E., $\frac{20}{50}$. Hyperopia of plus 3 D. She accepted and was given plus 1 D. both eyes, which could give a vision of only $\frac{20}{40}$ in each.

Examination of Cornea.—The center of each cornea extending out to the periphery shows numerous lattice-like spots, identical in form, size, and contour with those in her mother's eyes. They were more numerous than those in the older brother. Patient has never been sick, and is a good type of a healthy looking woman.

Patient was seen this year, 1912, and her vision was just the same, while the corneal spots remained unchanged. In none of these cases was there ever a history of any acute inflammatory symptoms.

CASE 5.—Earle H., aged twenty-three; has never complained of his eyes. Lives in Indiana, but was home on a visit. Came to office for examination by request.

V. = R. E., $\frac{20}{20}$; L. E., $\frac{20}{15}$. Has hyperopia of plus 1.50 both eyes. Examination shows left cornea clear, but on the right there are two spots at center, of the same character as those previously described.

CASE 6.—Miss Wilhelmina H., aged twenty, the youngest child. Has never complained of her eyes; came to my office by request and an examination was made. V. = R. E., $\frac{20}{30}$; L. E., $\frac{20}{40}$.

Retinoscopy shows plus 1.50 hyperopia, but vision is unimproved by glasses. Examination shows numerous opacities at the center of both corneas, but no irritation. Patient herself is strong and healthy.

It is a noteworthy fact that the females showed a very much more marked involvement of the cornea than did the males, and also that the same error of refraction was common to all.

In studying the literature bearing on this class of cases we are struck with the diversity of nomenclature. To my own mind it is evident that the pathology has much in common,

and the cases differ only clinically. In reviewing the histories of such cases I believe that they all could be placed under the category of what has been designated by Fehr and Fleischer as "Family Degeneration of the Cornea."

The historical data in reference to this class of cases have been published by various writers, and are no doubt familiar to members of this Society.

Dr. John Green, Jr., before the Ophthalmological Section of the American Medical Association in 1909, has reported a case and reviewed very thoroughly the history of the disease. His case presents some features quite distinct, and differs slightly from those here recorded. In discussing the literature as to the number of recorded cases, he states that "up to the present (1910) the literature contains only 22 authentic cases." Fleischer in 1905 published a very extensive article on this subject, in which he made the statement that up to that time 59 cases had been reported. This has no doubt been added to very materially since that article was written, but even now the number remains quite insignificant, when compared to the large number of other eye diseases which are yearly tabulated.

While various writers have given different names to this peculiar affection, and while the clinical picture differs in some minor details, there is so much in common that we are justified in considering it as different types of the same disease. The only exception to this statement is in regard to those cases where the corneal lesion begins, or at least is accompanied, by some inflammatory symptoms of congestion. I do not believe that such cases are of the same pathologic type, because one of the cardinal symptoms of this affection is the lack of acute inflammatory signs. It is of a distinctly chronic character, and but for the fact that a dimness of vision is noted, the patient rarely suffers any inconvenience. Cases reported as nodular which are

accompanied by inflammatory symptoms are rather to be classed as interstitial or neuropathic.

Fuchs' description of this corneal lesion is by far the clearest and most comprehensive yet written, corresponding entirely with every clinical feature of my own reported cases. The etiology and even the pathology of this affection are veiled in much obscurity. That such is a family trait is evident from the records of reported cases, and this seems to be the only universal characteristic.

Fleischer has called attention to climate as a possible causal factor in these cases, and cites the fact that the large majority of those observed by him came from a certain portion of the Alpine country, and also the fact that many of the other cases reported were by men who practised in mountainous districts. It is indeed remarkable that Fleischer and Spitta should have been able to meet with 34 cases of this disease in the clinic of Tübingen, unless location and the peculiar environments of the people of that district did not produce some decidedly causal influence.

Some have thought that the question of consanguinity played an important rôle, just as other degenerative changes in the body are attributed to this cause. The history of the cases, however, does not stamp this as an important factor, but as Fleischer states rather the fact is more important of intermarriage among families suffering with these degenerative types, and in a locality where the character of the inhabitants never changes, and which is rarely visited by strangers from the outside.

The question of this affection being dependent upon tuberculosis has its chief advocate in the writings of Wehrli. Dr. Green, Jr., considered his case to be one of a tuberculous nature, and in the discussion which followed, both Shumway and Zentmayer, from their personal experience, were in accord with this opinion.

Every tuberculous test was made in my cases with

absolutely negative results, both as to diagnosis and treatment.

I must admit that there are opacities of the cornea of a tuberculous character which resemble very much some of those designated as nodular keratitis, but the history of such shows that most of them in their incipiency were accompanied by decided acute inflammatory signs and marked corneal irritation.

The absence of all inflammatory signs must certainly be looked upon as one of the cardinal symptoms of this disease, and I believe that cases reported where this symptom is present must be regarded as a different type of this affection.

I agree fully with Fleischer in his argument against Wehrli as to the non-tuberculous nature and the fact of its being more of a hyaline degeneration than any other pathologic process. To translate Fleischer's language, "so long as the anatomic findings differ from the ordinary structure of the tubercle as the pictures of Wehrli show, I cannot accept them as tuberculous when so many clinical findings speak against it."

DISCUSSION.

DR. JOHN E. WEEKS, New York: These cases are, as we all know, extremely rare. The question of etiology, that is, in regard to their being tubercular, is one of a good deal of interest. It seems to me that tubercle can be excluded by the history. These conditions begin, as a rule, in early youth, but they advance as the individual grows older up to the age ordinarily of twenty or twenty-two years; after that they remain very nearly stationary, so far as my experience goes. Tubercle as it develops in the cornea is accompanied by more or less inflammation, and presents an opacity that is almost characteristic; it is quite white or a very light gray and the nodule, when it occurs as such, is a miliary tubercle and transient. It has no particular regularity in time of development. The history and the clinical picture present a pathologic condition which can hardly be confounded with this affection.

DR. DUNBAR ROY, Atlanta: I was very glad to be able to present these drawings, as the cases are exceedingly rare. I treated them for several months before I fully recognized the exact nature of the trouble. I then had other members of the family come to my office to see if there was such a thing as a family type. The lesions are typical in appearance. No inflammatory signs, with the exception that the patient's vision grows dim from opaque spots on the cornea. It is like meal bran scattered on the front of the cornea. These spots can be raised up, and underneath there is found a little opaque trabecula which indicates that the affection extends into the cornea proper. I tried curetment, the cautery, and other measures without avail. So few cases have been reported in this country that I believed the members of the Society would be interested in the report of the affection where it occurred in the mother and five children.

IDIOPATHIC HEMATOMA OF THE ORBIT.

E. GRUENING, M.D.,
New York.

Idiopathic hematoma of the orbit is extremely rare. The case of which I wish to give an account is the only one that has occurred in my own practice. R. Berlin, who wrote the chapter on Orbital Tumors in the first edition of Graefe-Saemisch, could find only three authenticated cases in medical literature.

My case was that of a young girl, Lillian P——, aged seventeen, who came to the New York Eye and Ear Infirmary on December 27, 1911, suffering from an exophthalmos of the right eye, which is accurately pictured in the accompanying photographs (Figs. 1 and 2). She stated that on December 15th she began to suffer intense pain in the right eye. She vomited several times, and was very drowsy. During this attack the right eye began to bulge forward.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Idiopathic hematoma of the orbit.

Two weeks later, as stated above, she was examined at the New York Eye and Ear Infirmary, where the following condition of her eye was recorded: The right eye has an exophthalmos of 15 mm. The degree of the protrusion was measured by the ophthalmometer. The direction of the protrusion was in the orbital axis. The ocular conjunctiva below the cornea was very chemotic and overlapped the lower lid, forming a sausage-like roll extending the whole length of the lower lid. The conjunctiva of the upper half of the globe was not swollen. The motility of the eye was greatly impaired, the excursions of the eyeball upward, inward, and outward did not exceed two mm. in any one direction. Motility downward was completely abolished. The media were clear, but the optic nerve presented a picture of choked disc. The summit of the elevation could be best seen with + 6 D. Vision of right eye = $\frac{1}{10}$. The left eye was perfectly normal. In the lower lid there was a suggillation which had appeared at the outset of the attack, and remained stationary during the time of observation—a period of six weeks. The girl was perfectly healthy, there is no hemophilia in the family, she had not received any injury, and neither she nor her parents could ascribe the sudden appearance of the swelling to any particular cause.

She was admitted to the hospital on January 15, 1912, put to bed, and kept on a light diet. Roentgen-ray examination of the accessory sinuses and of the orbit made by Dr. Dixon, clinical exploration of her nose and its sinuses by Dr. Dench, and the Wassermann and von Pirquet tests were all negative.

She was kept on her back from January 15th to January 26th, given large doses of potassium iodid, and cold compresses were applied to the protruding eye. During all this time there was no diminution in the amount of the protrusion. She suffered no pain and had no elevation of temperature. When this condition had lasted about six

weeks without improvement it was decided to explore the orbit to discover the nature of the disease. Inasmuch as involvement of the accessory sinuses had been excluded, and any vascular growth as well, since there was no perceptible pulsation or susurrus in the orbital tumor, it was assumed in view of the youth of the patient that we had to deal with a rapidly growing orbital sarcoma. This view was shared by many colleagues who were kind enough to examine the case with me.

On January 26th the skin incision for the Krönlein operation was made with the view of resecting the outer wall of the orbit in case of necessity. Following the skin incision I inicsed the orbital fascia. Immediately a soft encapsulated mass protruded into the incision. It was not orbital fat, and it was not anything that is usually found in the orbit. I incised this mass, and evacuated a large quantity of fluid blood. When the sac was emptied there was no further flow of blood, so I had not cut into a sac connected with an open vessel.

In this case of exophthalmos of 15 mm. I was able to explore with my finger the whole orbital cavity, and convince myself that there was no other cause for the protrusion. I mention the ease with which the digital examination could be made in this case because in the exophthalmos of lower degree the digital exploration is difficult even after the resection of the external bony wall of the orbit. The eyeball receded into the orbit, the cutaneous wound was closed with interrupted sutures, and the patient was cured of her orbital tumor. She looked ten days after the operation as she appears in the accompanying photographs (Figs. 3 and 4). The optic neuritis disappeared, and she regained her sight. The motility of the eye was fully restored upward, inward, and outward. The downward immobility remained, perhaps owing to the destruction of the rectus inferior muscle or the nerve supplying it.

Adami, in his Principles of Pathology, writing of hemorrhagic cysts, says: "The extensive hemorrhages into the substances of sundry organs may result, not in the ultimate absorption of the exuded fluid, but in cyst formation. The hemorrhage leads to the destruction of the tissues of the infiltrated area, and eventually a capsule is formed around the exuded blood." This is evidently the process which took place in this case.

The suggillation of the lower lid has probably a diagnostic significance. In Merkel's "Anatomy of the Orbit" it is stated that the septum orbitale forms a strong and firm barrier above and at either side. Below, however, it is perceptibly thinner, and particles of orbital fat at times force their way through it. The likelihood is that in this hemorrhage in the cellular orbital tissue some blood followed the path of least resistance and appeared under the skin of the lower lid. As such persistent suggillation in the lower lid does not happen in other forms of tumor of the orbit, we may consider it pathognomonic of certain forms of spontaneous orbital hemorrhage.

CALCAREOUS DEGENERATION OF THE CORNEA AND LENS CAPSULE.

FREDERICK TOOKE, M.D.,
Montreal, Canada.

Lesions of the cornea manifesting calcareous changes have been variously described clinically as calcareous keratitis, primary or zonular opacity of the cornea, transverse film of the cornea, keratitis trophica, and keratitis or "keratite en bandalette." Some authors have attributed these opacities to an excess of uric acid, while others consider them due to external injurious influences.

Referring to the ribbon-shaped variety of opacity, Ball* says that it may be either congenital or acquired; the former type is of exceedingly rare occurrence. In the acquired form it is present in two distinct clinical types; in the one the interpalpebral part of the cornea of eyes which were previously normal becomes opaque, owing to the development of a smooth subepithelial covering; in the other type an oval transverse band develops in eyes which have long been blind from iridocyclitis, sympathetic ophthalmia, or from glaucoma. This form of opacity produces a roughening of the cornea, and occurs chiefly in the lower third of this tunic. Since this is the part of the eye which is exposed when the globe is rolled upward, as in sleep, the condition has been considered to be due to imperfect closure of the lids; in other words, an exposure keratitis.

In the first type the local change consists in a deposit of lime salts beneath the epithelium which is unaffected. The opacity is sharply defined, while the remaining cornea is clear. This opacity may form a gray area, three to five mm. in width, passing across the cornea below the center of the pupil. There is frequently an oval opacity at the outer and another at the inner part of the cornea, separated from the limbus by clear corneal tissue. The two oval masses are connected by a bridge through which the pupil can be seen.

Lime salts may be deposited in the cornea either in connection with hyaline degeneration or without such association. Such deposits sometimes occur superficially as band-like opacities, sometimes as infiltrates of small particles, and occasionally in old scars as larger plate-like masses. De Schweinitz † has recognized a clinical condition of retrogressive changes with the deposition of hyaline masses and lime particles in thick corneal scars and staphylomata, and refers to various forms of treatment.

* Modern Ophthalmology, pp. 334–346, 349–351.
† Diseases of the Eye, pp. 339, 361–362.

A lattice form of opacity of the cornea as described by Freund* is hardly comparable to the case under consideration. It is of hereditary origin, its commencement is gradual, and it reaches its full development between the ages of thirty and forty. The opacity is thickest in the center of the cornea, both eyes are also affected, and the deep as well as the superficial layers of the cornea are involved.

Gilbert† thinks that the calcification of superficial scars is secondary to hyaline degeneration, since the lime deposits are never found without the hyaline, while hyaline substance occurs alone; but it, in turn, is secondary to coagulated fibrin. When Bowman's membrane is not destroyed in leucomata, it is found to be involved in the degeneration. He further considers some disturbance of the local nutrition and metabolism as being the principal factor in producing the pathologic changes.

Fuchs‡ says that the anatomic changes which underlie zonular opacity of the cornea consist in the deposition of lime in the form of very minute granules in Bowman's membrane, which later becomes opaque, white, rigid, and brittle. In the spots where the calcification is far advanced one ordinarily finds new-formed connective tissue on Bowman's membrane, between it and the epithelium; owing to the presence of this tissue the surface of the epithelium tends to become irregular. Acting in the opposite direction, the connective tissue pushes Bowman's membrane backward, causing breaks in it and displacement of the broken portions. In advanced cases minute granules of lime also make their appearance in the lamellæ of the substantia propria lying beneath Bowman's membrane.

So very little has been written upon this rather obscure form of corneal degeneration from a pathologic standpoint

* Graefe's Archiv. f. Ophth., vol. lvii, 1903, p. 2.
† *Ibid.*, 1909, vol. lxxii, S. 337.
‡ Lehrbuch der Augenheilkunde, ii. Aufl., S. 243.

that I am presenting this case before the Society as one of interest and consideration.

E. P., a male, of French Canadian extraction, aged forty-two, came to the Royal Victoria Hospital, Montreal, complaining of recurring attacks of pain and inflammation in and about the eyeball. He stated that up to a year and a half previous to his admission the eye had been a normal, healthy one. At the time referred to, while working in a sand pit, some material was forcibly blown into his eye; he was temporarily blinded, and from his description of the course of events a superficial ulcer of the cornea must have followed. The patient stated that he did not seek for special advice, and that the eyesight was gradually lost—completely so at a comparatively short time after the accident. Recurring attacks of pain and inflammation manifested themselves, subsiding only to recur with greater intensity. The attacks finally became so severe that he decided to come to Montreal for relief.

As seen at the eye clinic, the patient was a strong, vigorous man, and healthy in all particulars save his injured eye. On examining the cornea, a round, dense scar was noted in the center completely covering the pupillary area. It occupied about the central quarter or third of the corneal surface, and was yellowish gray in color, and was but slightly flattened. The corneal epithelium was intact over this opacity, the substantia propria not staining with fluorescin, and there did not appear to be any ingress of superficial vessels into the apparently healed scar. The opacity completely covered the pupillary area; the peripheral fibers of the iris seemed to be normal; the anterior chamber was of normal depth and free from exudate. There was a very moderate degree of pericorneal injection with some congestion of the branches of the anterior conjunctival veins. The intraocular tension was distinctly raised, and perception of light was absent.

The eye was enucleated as blind, the result of an advanced glaucomatous process, and recovery was uneventful. After fixing the specimen in formalin, the eye was frozen and bisected. While doing so the lens became detached from the zonule, and when, separated from the eyeball, I further tried

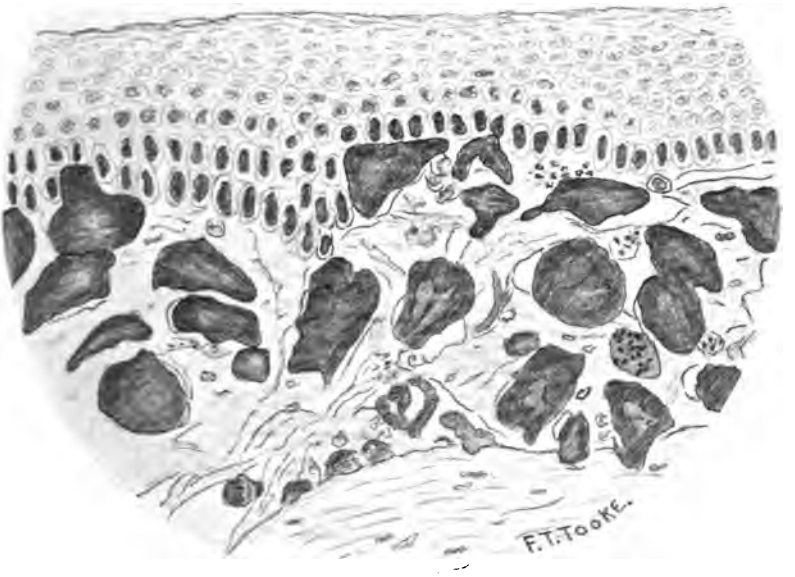


Fig. 1.—Reichert Obj. 6. Polymorphous plaques in superficial layers of substantia propria as well as occupying the site of a degenerate Bowman's membrane. No evidences of a previous inflammatory disturbance. Section taken from center of pupillary area.

Fig. 2.—Reichert Obj. 3. Occlusion of filtration angle: root of iris in apposition to Descemet's membrane, but otherwise anterior chamber is of normal depth.

to cut it across, it cracked unevenly like an egg-shell, a degenerate cortex escaping from within the calcareous fluid of very much the same consistence as egg-albumen. The covering which I have described as an egg-shell was white in color, perfectly regular and smooth as regards its surface, but rather rougher on its inner surface, although the color is unchanged. By treating a particle with dilute sulphuric acid a distinct effervescence occurs, liberating free carbon dioxid and forming the characteristic calcium sulphate or gypsum crystals, proving the substance to be a true calcium carbonate. Staining and mounting a small particle with Loeffler's methylene-blue as well as with hematoxylin do not reveal any of the features of true bone tissue, the specimen showing up as an amorphous mass which appears to absorb the methylene-blue particularly well.

The anterior portion of the eyeball was imbedded and mounted in celloidin, and sections stained with hematoxylin and eosin, with methylene-blue, and with van Gieson's stain. The sections show a distinct proliferation of the corneal epithelium over the pupillary area, the superficial cells being of the stratified type. Beneath the epithelial layer one comes upon Bowman's membrane, which is not wrinkled or altered at its periphery; at the center of the section, however, this membrane appears to have undergone a distinct degenerative change. At some points it appears to be swollen, at some places atrophied, and at others a certain degree of coarsely granular change has taken place in the membrane not noticeable in other tissues in the section. There is, apparently, no areolar or connective tissue between the epithelial layer and Bowman's membrane, and superficial vessels are not to be seen in the center of the section.

There appears to be a certain degree of hyaline degeneration beneath Bowman's membrane, the definite or distinct layers of the cells of the substantia propria manifesting a certain element of degenerative alteration seldom noted in

non-inflammatory conditions of the cornea. About Bowman's membrane, and beneath it in these areas of hyaloid change, are large, irregular, amorphous masses which cut with a definite element of resistance and grittiness, leaving the corneal tissue about them rather shredded and torn. These masses stain regularly and intensely with methylene-blue as well as by hematoxylin; they stain particularly well with the iron hematoxylin as employed in van Gieson's stain. These plaques are noticeable in the superficial layers of the substantia propria of the cornea, some, in fact the most, either in or directly beneath Bowman's membrane, while other deposits are seen above it, appearing in some instances to shove the epithelium away from the hyaloid tissue (Fig. 1). One can, in fact, notice certain instances where the salt appears directly contiguous with Bowman's membrane at one end, the crystal projecting upward into the epithelial cells in the opposite direction, while some of the epithelium would appear to undermine this deposit, apparently separating part of it from the hyaloid tissue beneath.

This deposit or concretion is distinctly most intense about the center of the sections, and is confined chiefly to the more superficial strata of cells. Microscopically one cannot detect the actual presence of any blood-vessels either of recent or of previous origin; further, one is able to note scattered throughout the superficial cells of the substantia propria but very few lymphocytes as evidence of an earlier inflammatory condition and possible vascularization. At the limbus, however, one may notice a deposit of these cells about the walls of the terminal superficial blood-vessels. One is hardly prepared to state whether this deposit has been laid down from the blood-vessels or through the lymphatics. In all probability the former idea would be substantiated from a view of the sections if one is to consider the evidence of Leber,* as well as that of Sachsalber,† who state that hyaline

* Bericht der Ophth. Gesellsch., 1897.
† Beitrage z. Augenheilk., xlviii, 1901.

concretions eventually become calcareous, but that calcification occurs also by primary deposition.

Regarding the ingress of these cells into the epithelial layer of the section, my findings would appear to bear out the statement of Parsons,* who finds that calcareous deposits in and on Bowman's membrane lead to its being broken up both vertically and longitudinally. He further states that the masses are frequently pushed up into the epithelium, which is always more or less altered, often degenerated and atrophic. The same author also remarks on the presence of new connective-tissue elements about the calcareous masses, attributing this to the irritation which they set up. Giant-cells in some cases have been noticed; they are absent in the case under discussion.

The presence of a calcareous substance in the cornea not being anticipated clinically, chemical tests were not attempted with the fresh tissue before it was imbedded. The subsequent treatment of the sections when imbedded was only partly satisfactory, as they did not permit of a sufficient amount of lime salts to be deposited for a routine chemical examination. The treatment of the sections, however, beneath the microscope under low power with dilute sulphuric acid produced a distinct effervescence; but disintegration of the lime salts with the celloidin was so intense that the character of the anticipated calcium sulphate crystals could not be distinguished.

On examining the filtration angle, one can notice a characteristic occlusion at this neighborhood (Fig. 2). The root of the iris is in apposition to Descemet's membrane for some distance, but the chamber itself is of normal depth. Although the iris would suggest a condition of chronic inflammation by a distinct infiltration of leucocytes, still there is no exudate within the anterior chamber, and synechiæ are not present. There is, further, but little engorgement of

* The Pathology of the Eye, vol. i, pt. 1, pp. 242, 243.

the vessels of the ciliary body, no plastic exudate can be made out upon the ciliary processes, and cyclitic dots are not present.

The condition in the cornea is not to be confounded with hyaloid degeneration, as noted in old leucomata, anterior staphylomata, and band-shaped opacity. This may also appear yellow in color, and seem to project above the surface of the cornea. This condition is usually limited to the more superficial layers of the corneal tissue and appears microscopically as homogeneous, highly refractile globules. The earlier evidences are minute granules which coalesce to form round globules, finally into larger masses, which generally show their mode of growth, as Parsons further states, by accretion in their crenate edges. Such material is very insoluble, resisting most reagents with the exception of concentrated alkalis and acids. Its staining properties, too, differ somewhat from that of calcium salts, absorbing acid fuchsin and methylene-blue, but staining poorly, if at all, with hematoxylin. Weigert's fibrin stain colors the granules but not the larger globules; the reaction of other staining materials shows by the variety of effect that one is dealing in such instances with no stable chemical body. This is further demonstrated by the fact that amyloid reactions are occasionally given typically, but more frequently in an indefinite manner or not at all. The microscopic features of such lesions have been thoroughly discussed by Baquis* and others.

Regarding the condition of the lens capsule, I consider that I am dealing with a unique condition. It is known that calcification of the lens may occur within the intact capsule, and that it is frequently found in the final stages of complicated cataracts and in shrunken globes. Partial calcification is met with in old anterior capsular cataracts. Actual

* Archiv. f. Ophthal., xlvi, 3, 1898.

ossification of the lens can occur only after a rupture or wound of the enveloping capsule, since only under these conditions can osteoblasts gain access to the interior. H. Muller and Knapp* have denied the possibility of ossification, Virchow has doubted it, while Berthold† held that it had not been demonstrated. Parsons,‡ to whom I have already referred, says that there is no question as to its occurring in old shrunken globes after rupture or absorption of the capsule and invasion of the lens by connective tissue of cyclitic origin.

The condition in the lens, as well as in the cornea, is not to be confounded with that of an actual bone formation as found as a post-inflammatory feature in old atrophic eyes. The condition met with here I hold to be a primary degenerative process purely, not preceded by previous inflammatory alterations. The secretion of calcium salts in this instance is quite comparable to that form of degeneration exhibited in the formation of vesical or renal calculi. How the deposit of lime salts is laid down in the capsule I am unprepared to say. One can suggest, however, that with the complete calcification of the capsule necrosis of the cortex results, with an ensuing autolysis or self-digestion of the lens fibers—a process quite different to bony degeneration, where the fibers of the cortex would be included in the pathogenic process. The occurrence of a deposit of lime salts in two separate hyaloid membranes of the eye is particularly interesting, and perhaps of some significance at the present time, in view of the diversity of opinion held by Wells and Klotz regarding calcareous alterations in the arteries, the former holding that the condition arises from hyaloid elements, the latter, that it is preceded by fatty degeneration.

* Archiv. f. Ophthal., 11, 1871.
† *Ibid.*, xvii, 1, 1871.
‡ The Pathology of the Eye, vol. ii, p. 427.

FRACTURE OF THE SKULL WITH HEMORRHAGE INTO THE OPTIC NERVE-SHEATHS AND RETINAS: MICROSCOPIC EXAMINATION OF THE EYEBALLS.

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Philadelphia.

Among the interesting ocular lesions which may take place as the result of head injuries, particularly fracture of the skull, are hemorrhages into the optic nerve-sheaths, vitreous, and retina. The literature is not an extensive one, although several notable papers on the subject have been published. To some of these we may refer:

Joseph Talko,* at the autopsy on a patient who sustained a transverse fracture of both parietal bones, found bilateral extravasations in the optic nerve-sheaths, extending from the optic foramen to the lamina cribrosa, and also hemorrhage in the left vitreous. The retinal vessels were overfilled, but retinal hemorrhages were wanting.

Panas'† interesting communication to the French Academy of Medicine on the ophthalmoscopic findings after cerebral traumatisms, and which was the subject of an investigation by a committee, contains references to four observations of effusion of blood into the cavity of the arachnoid, and of bloody serum, or blood itself, finding its way along the intervaginal space to the sclerotic. Although not entirely germane to the subject, it is not without interest to point out that at this early date, thirty-six years ago, Panas demonstrated that choked disc often develops in con-

* Klin. Monatsbl. f. Augenheilk., xi, 1873, p. 341.
† Bulletin de l'Académie de Médecine, xli, 1876, p. 182, 334.

sequence of diverse traumatic lesions of the brain and that this choking of the disc is not always accompanied by visual disturbances. He urged that all patients with head injuries should be submitted to thorough ophthalmoscopic examination for the purpose of determining the fundus lesions under these conditions.

He also referred to Manz's case of hemorrhagic pachymeningitis, reported in 1872. At the autopsy a considerable distention of the intervaginal space was found because it was filled with blood and bloody extravasation. All of the cranial cavities were also distended with blood and blood-stained serum.

Hölder, freely quoted by Berlin* in his discussion of the visual disturbances caused by injury of the skull produced by a blunt force, found among 126 personally observed fractures of the skull, 54 with fracture of the optic canal, and in 42 of them there was hemorrhage into the sheaths of the optic nerves.

Priestley Smith† describes the case of a mechanic, aged thirty-eight, who, as the result of a fall, developed an extravasation into the substance of the frontal lobe. Some days later hemorrhage occurred, which extended over the surface of the brain and forced its way into the optic nerves. Examination of these nerves indicated that the blood-clot was situated entirely external to the arachnoidal sheath, although the subarachnoidal space was widely distended. As Mr. Priestley Smith expresses it, the disease appears to have performed a double injection, the blood, passing over the surface of the brain immediately behind the dura mater, had forced its way along the subdural sheath of the nerve, while at the same time the subarachnoidal space had been injected with colorless fluid, doubtless the cerebrospinal fluid forced into it from the subarachnoidal space of the brain by the increased pressure within the skull.

* Bericht der ophthalmologischen Gesellschaft, Heidelberg, 1879, p. 9.
† Trans. Ophth. Soc. U. K., iv, 1884, p. 271.

Dr. A. Quarry Silcock* found the following lesions in a man, aged twenty-eight, who died from the effects of a fracture of the skull eight days after the injury: The fracture traversed the posterior-inferior angle of the right parietal bone and the right half of the occipital bone, and extended from a point two inches above and four inches behind the right external auditory meatus to the jugular foramen of the same side. In the cavity of the arachnoid there was much extravasated blood. The sheaths of the optic nerves were discolored, and the clot occupied the subdural space of the nerve into which the blood had found its way from the arachnoid. There was no fracture of the optic foramen.

Otto Schnaudigel† found in an epileptic who had several times fallen and injured his head, among many hemorrhagic extravasations, subpial and subdural hemorrhage over the convexity and base of the brain, as well as hemorrhage into the optic nerve and under its dural sheath. Hemorrhages were also found in the retina, choroid, iris, etc.

In a discussion of the optic nerve changes associated with fracture of the skull, making special reference to hematomas of the optic nerve-sheaths, Uhthoff‡ contributes a thorough and well-illustrated article, with a review of literature bearing directly and indirectly upon this subject. Two cases are reported. The first concerned a man, fifty-six years of age, who as the result of a fall upon the head sustained a fracture of the base and extensive extradural and intradural hematoma. The optic nerve-sheaths were distended with blood, the breadth of the blood layer being from 1 to 1½ mm. The second case concerned a man, aged twenty-eight, who fell upon his head, and was examined one and a half hours after the accident. The eyeballs were prominent, the optic papilla of the left eye was surrounded

* Trans. Ophth. Soc. U. K., iv, 1884, p. 274.
† Arch. f. Ophth., xlvii, 1899, p. 490.
‡ Bericht über die Versammlung der ophthalmologischen Gesellschaft, Heidelberg, 1901.

with blood, and in the macula were small hemorrhages. In the right eye the papilla presented the picture of a neuroretinitis apoplectica. There were also hemorrhages in the macula. At the autopsy fracture of the parietal bone and hemorrhages in the white substance of the brain were found; and the pia mater at the base was extensively infiltrated with blood. Both optic nerve-sheaths were distended with blood. In some places there was a pure subdural situation of the hemorrhage. In other places the blood had distended the arachnoidal tissue of the sheath.

With the title "Fracture of the Skull and the Eye," Liebrecht of Hamburg* makes a noteworthy contribution to this entire subject, with liberal references to the literature which is directly and indirectly concerned with it. In general terms Liebrecht discusses the pathologic findings in the optic nerve in fracture of the skull, and found among 26 fractures, the subjects of which had died, 55% of hemorrhage into the optic sheath. That traumatism of the skull is not infrequently the cause of hemorrhage into the optic nerve-sheaths is pointed out by Wilbrand and Saenger,† who also give a summary of the cases which bear upon this topic.

With this brief reference to the literature we place on record the following instance of this condition of affairs:

A white man, aged forty-five, was admitted to the Hospital of the University of Pennsylvania in the service of Dr. John B. Deaver, with the history that he had been found unconscious on the sidewalk by a policeman. It was not known by the officer whether the unconsciousness was the result of a fall, or whether he fell because he lost consciousness. Within half an hour after his admission to the hospital he was examined by one of us (Dr. de Schweinitz), and the following conditions noted: Patient unconscious, breathing somewhat stertorously; both pupils semi-dilated, the right one larger than the left; eyes not prominent; no sub-

* Archiv f. Augenheilk., lv, 1906, p. 36.
† Die Neurologie des Auges, iv, p. 627.

conjunctival discoloration. Over the fundus of the right eye were numerous large hemorrhages, not specially massed in any one portion of the fundus, but fairly evenly distributed, with a little tendency to be greater in the macular region than elsewhere; one large hemorrhage covered the disc above and another one below, so that only the central portion of the disc itself was visible. Both sets of vessels appeared somewhat distended and the arteries showed the early signs of sclerotic change in their walls. The appearances of the left fundus were similar; if anything, the hemorrhages were more extensive, one hemorrhage partly covering the whole area of the disc and extending some little distance on each side of it. The patient's pulse was rapid and hard, a few râles were heard in the chest, the heart area was normal, the systolic blood-pressure 195, and the diastolic, 95. In the urine there were a cloud of albumen and many hyaline and dark granular casts. Externally the scalp gave no evidence of injury; that is to say, no wound or cut was visible, but there was a pulpy area in the parieto-temporal region.

The patient died in less than an hour after admission and at the autopsy made about twelve hours later the following conditions were found: Lungs, slight congestion; adhesion to the right pleura posteriorly. Heart, some fatty degeneration, slight fibrosis of the valves, both aorta and coronary vessels somewhat atheromatous. Liver enlarged and slightly fibrous. Stomach dilated, its thin walls containing distended veins. In each kidney some fatty degeneration and a tendency to granular change were evident. In the skull there was a fissure fracture, extending from the posterior occipital protuberance near the parieto-temporal suture to the base of the zygoma. Over this area there was a hemorrhage into the scalp. A profuse subdural hemorrhage was present involving the whole cerebrum, but not the cerebellum. Over the median portion of the frontal lobe were a number of meningeal hemorrhages. It was not possible to obtain the entire eyeball, but the posterior half of each eyeball was cut away and the optic nerves as far as the chiasm. It was noted by one of us who was present at the autopsy (Dr. Holloway) that there was distinct ampulliform enlargement of the sheaths.

Macroscopic and Microscopic Examination of the Nerves.—The sheaths of both optic nerves are distended with blood,

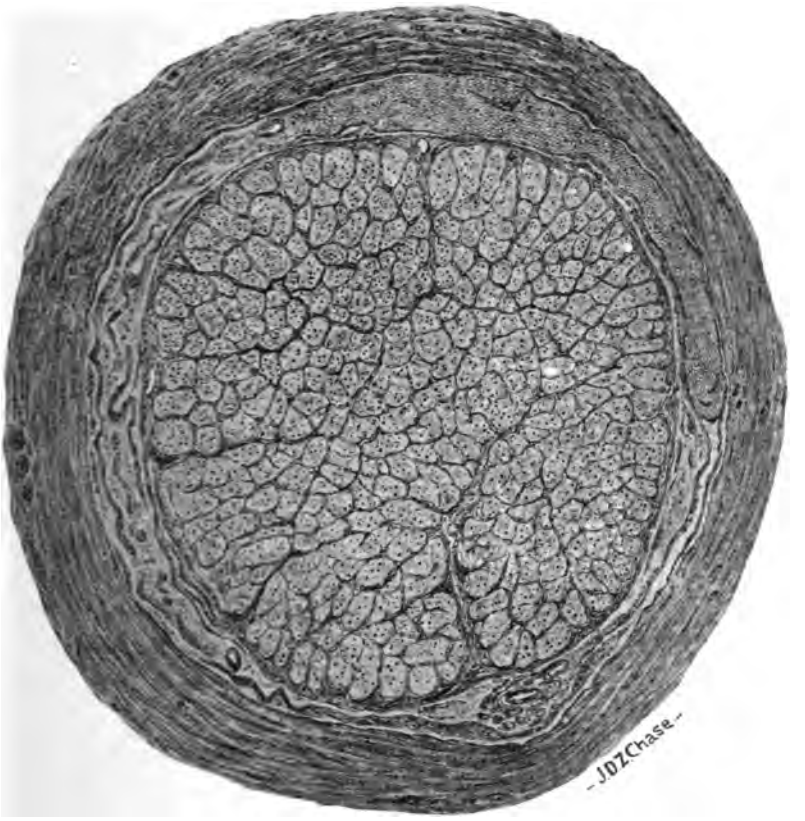

Fig. 1 —Transverse section of right optic nerve, showing the subdural hematoma.

forming a layer varying in diameter from ½ to 1½ mm. The distention of the sheaths with blood is about equal on each side, perhaps a little greater in the left sheath. In general terms, the hematoma is subdural and is greater in each sheath in one portion than elsewhere; *i. e.*, the extravasation is not evenly divided. As in other instances, for example Uhthoff's specimen of this affection, the blood is not entirely subdural, but in following its distribution in places it may be noted that the arachnoid is also infiltrated. There appears to be no involvement of the optic nerve-fibers; *i. e.*, there has been no entrance of blood into the tissue of the nerve. Although ophthalmoscopically many retinal hemorrhages were visible, these do not appear abundantly in the specimens submitted to microscopic examination, although extravasations of blood are evident here and there in the fiber layer. The retinal blood-vessels, and also those of the choroid, are fully distended with blood (Figs. 1 and 2).

The Mechanism of Hematoma of the Sheath.—Among 126 fractures of the skull personally investigated by Hölder, 88 were concerned with the base and in 54 of them there was a fracture through the wall of the optic canal, and, as before mentioned, in 42 of these 54 instances there was hemorrhage into the sheath of the optic nerve. These hemorrhages were sometimes unilateral and sometimes bilateral; but Hölder states that he never found a hemorrhage into the sheath without coexisting fracture of the optic canal. While he is unwilling to deny the possibility of entrance of blood into the sheath in fracture of the skull without fracture of the canal, he feels that such an occurrence is an unusual one. That hemorrhage into the intervaginal sheath of the optic nerve in fracture of the skull may occur without associated fracture of the optic canal is, however, well established. Thus, in Uhthoff's well-examined and reported cases of double hematoma of the intervaginal sheath, there was neither fracture nor fissure of the bony optic canal. Moreover, prior to the report of these cases, as he points out, others described by Talko, von Bergmann, Silcock, and Panas

had demonstrated the independence of hemorrhage into the intervaginal sheath and optic canal fracture. In our own patient there was no injury of any kind demonstrable in the optic canal.

Liebrecht's investigation of 26 fractures of the skull which terminated fatally, with 55% of hemorrhages into the sheath, led him to believe that in a small number of the cases free blood entered from the cranial cavity. In case the optic canal is injured the blood from the ophthalmic artery presses in the wide-meshed lymph-spaces of the dural sheath and further dilates them, a condition of affairs which he believes to be present in the greater number of cases of fracture of the bony walls. In his experience hemorrhage was always more severe in the subdural space than in the subarachnoid. He questions the permeability of the sheath, and when hemorrhage occurs in the papilla or in the retina he believes it to be a result of the permeability of the veins in the eye in consequence of sudden change in the blood-pressure. According to him, hemorrhage enters most readily, as a rule, at the apex of the orbit, where the nerve leaves the canal and where the tissue of the dural sheath is most vascular. Hemorrhages were marked within the dural sheath and the insertion of the eye muscles. He found that hemorrhages arose in all probability from the vessels which enter the dural sheath from the bony canal into the periosteum and extended into the dural sheath and along the lymph tracks into the intervaginal sheath. It would seem, therefore, that these hemorrhagic extravasations into the sheaths of the optic nerve may be caused by—

(1) Fracture of the base of the skull involving the optic foramen, and that the blood may be derived from vessels which enter the dural sheath; (2) that similar hemorrhagic extravasation may be the result of a direct entrance of blood into the nerve-sheaths, the bony optic canal being perfectly intact. This blood may find its way into the intersheath

Fig. 2.—Longitudinal section of left optic nerve, showing situation of the hematoma.

in the same way that an injection fluid may be artificially forced into the cavity of the arachnoid (Silcock), pronounced increase in the intracranial tension being a necessary adjunct in driving the blood into the optic nerve-sheath.

Concerning the diagnosis of hemorrhage into the sheath of the optic nerve, which has occasioned considerable discussion, it may be said, in the first place, that the mere presence of blood on and around the edge of the optic nerve is not pathognomonic of the condition, although it may be suggestive. Panas' investigation indicates that the accumulation of blood-stained cerebrospinal fluid in the sheath may be the cause of edema and swelling of the papilla, and that, therefore, as Gonin puts it,* the only definite manifestation of an apoplexy into the sheath is a moderate degree of papillary stasis, with or without hemorrhage along the retinal vessels. Moreover, it is probable that the absence of all ophthalmoscopic symptoms would not justify the exclusion of the diagnosis of hemorrhage into the sheath, even, as Gonin maintains, of a very abundant hemorrhagic extravasation.

While not entirely germane to the present subject, it may be interesting in conclusion to make reference to a curious ophthalmoscopic lesion which has been seen after fracture of the skull or blows upon the head; namely, collections of white spots which apparently are not of retinal origin, and which are supposed to be derived from the perivascular lymph-sheaths. They have been referred to by Purtscher,† were also noted by Liebrecht, who attributed them to changes in the glial elements, and are described by Körber‡ under the title of "Lymphorrhagia of the Fundus in Fracture of the Skull," and by Gonin§ in a consideration of the retinal alterations which follow fracture of the skull.

* Annales d'Oculistique, cxxix, cxxx, 1903, p. 89.
† Bericht der ophthalmologischen Gesellschaft, Heidelberg, 1910, p. 294.
‡ Centralbl. f. prakt. Augenheilk., xxxiv, 1910, p. 355.
§ Annales d'Oculistique, cxlvii, 1912, p. 98.

DISCUSSION.

DR. HOWARD F. HANSELL, Philadelphia: The subject is one of very great interest to the ophthalmologist and the surgeon and to the neurologist, and may be looked at from a little different standpoint from the one which has been so ably laid before us. I refer to the cases in which the hyperemia is diagnosed a week or two after the injury. My attention was called to this by a case in which I was asked to examine the eye-ground of a woman, thirty years of age, the victim of a trolley accident, who was brought to the Jefferson Hospital by Dr. Nassau the past winter. The head had been jammed between two unresisting substances. Dr. Nassau was unable to recognize that she had fracture of the skull. When I looked at the eye-ground I found decided hyperemia, and tortuosity of the veins without edema or hemorrhages. She was in bed and in such a critical state it was impossible to go further with the examination. On my report on the eye-ground Dr. Nassau determined to operate, and so he performed an osteoplastic operation on each temple, and removed a large clot of blood from each side between the meninges and the bone. He said that he had done this operation because of my report. The venous hyperemia of the retina entirely disappeared as the woman recovered. I think that the hyperemia was not due to the direct injury, but was a symptom of commencing optic neuritis or choking of the disc, such as we see in tumors, because of the collection of blood compressing the circulation.

POLYPOIDAL FORMATION IN THE LACRIMAL SAC.

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Polyps of the lacrimal sac are seldom met with if we are to accept the statement of Wagenmann.* The paucity of cases recorded in ophthalmic literature would seem to bear out this assertion. No less an authority than Kuhnt † claims that polyps in the tear-sac are exceedingly rare, while Hertel ‡ records that after a microscopic examination of 52 tear-sacs a polyp was found in one case only. From a series of 50 excised sacs, which I have personally examined microscopically, I have found definite polypoidal structures present in two cases, a somewhat higher percentage than that of Hertel as well as, I presume, that of Wagenmann. The fact that a systematic or routine examination of excised lacrimal sacs is not carried out by the majority of ophthalmic surgeons who practise the operation of the subperiosteal extirpation of the sac may be held as partly responsible for the fact that in this, as in many other questions of definite pathologic interest, much valuable material is permitted to be overlooked, if not, indeed, actually neglected.

It is, however, known that published records of polyps of the lacrimal sac are few. The two cases which I am presenting have a clinical as well as a pathologic interest.

CASE 1.—B. D., a young French Canadian woman of about twenty years of age, came to the Royal Victoria

* Bericht. der ophthal. Gesellsch., Heidelberg, 1906.
† *Ibid.*, Heidelberg, 1891.
‡ Von Graefe's Archiv., Bd. xlviii.

Hospital, Montreal, about a year ago, complaining of recurring attacks of pain and swelling over the right tear-sac. Her description of one of these attacks, which seems to have been attended with more pain than usual, almost suggested an attack of facial erysipelas. The patient stated that although she was troubled with her eye watering persistently, she had never noticed a purulent discharge about the eye. She had been in attendance at one of the French Canadian institutions, where she says that an operation had been performed for the removal of the sac a few months before.

Beyond the ordinary illnesses of childhood she had always enjoyed good health, and the patient had the appearance of an unusually robust young woman. She had been several times in the out-patient department, where drops were prescribed as a placebo. The sacs had never been probed, at least not so far as I could learn, and the canaliculi had not been slit. There was no discharge of any kind upon pressure exerted over the sac. A diagnosis of stricture of the duct was established by means of the lacrimal syringe. There was no apparent thickening of the tissues in the region of the sac or any evidence of bulging or tumor mass beneath the skin surface. A small crescentic scar about 1.5 cm. in length, which had healed by primary intention, could be seen in the customary site of the initial incision for removal of the sac, extending from about 2 mm. inside of the palpebral ligament, downward and outward, corroborating the patient's statement that operative interference had been attempted. The department of rhinology reported a condition of rhinitis chronica as well as a hypertrophic condition of the tonsils. There were also multiple tiny ulcerated patches in the buccal mucous membrane which were diagnosed as non-specific, and which cleared up after the use of an antiseptic mouth-wash. A Wassermann reaction was not attempted. There was, further, no evidence of nasal polyp, and the accessory sinuses were apparently in a healthy condition. The lids and conjunctiva were normal and the cornea did not show any scars which would lead one to suspect a prior infection from the conjunctiva or lacrimal sac. The patient's visual acuity was normal.

She was subjected to ether anesthesia and the sac excised

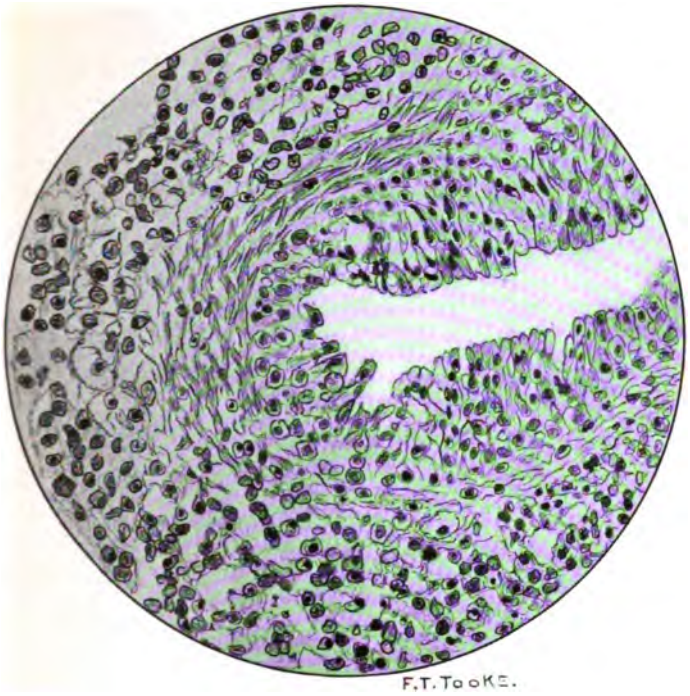

Fig. 1.—Reichert. Obj. No. 7.

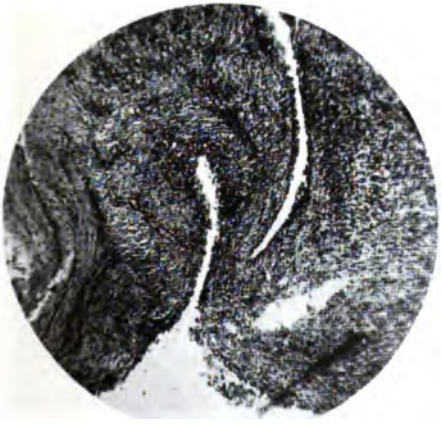

Fig. 2.—Reichert. Obj. No. 3.
Polypoidal Formation in the Lacrimal Sac.

in accordance with the procedures recommended by Axenfeld.* The course of the old scar was followed rather closely, but curiously enough I did not find the amount of cicatricial tissue or the thickening of the periosteum that I had anticipated, the operation being an unusually easy one. The sac was not unduly adherent to the periosteum by any inflammatory adhesions, but was easily exposed and removed without lacerating it. After the removal of the sac, a small incision was made across its equator, which fortunately happened to be directly over the site of the polyp, its attachment apparently being at the nasal or posterior wall and directed upward and outward. It measured about 4 by 2 mm. The polyp is seen to be pencil-shaped and is definitely pediculated at its point of attachment, with a suggestion of one or two accessory polyps appearing at this point. It is of a mottled red color, resembling in this respect the case described by Wagenmann, suggestive of its being composed of strangulated vascular tissue. I removed a part of the sac-wall above the polyp for microscopic examination, while the balance of the sac with the polyp intact I am presenting as a gross specimen.

On examining sections from the excised portion of the sac, one notices evidence of acute or subacute inflammatory disturbance in the mucous membrane. The cylindrical epithelium is intact and for the most part is regularly distributed over the mucosa. Some of the epithelial cells, more particularly the deeper ones, are inclined to be swollen or edematous, corresponding to well-known changes which have been observed in early inflammatory or edematous conditions involving the corneal epithelium. The epithelium is not arranged in little tufts or clumps such as one frequently finds to be the case in acute inflammatory conditions of the sac. The epithelium is not exfoliated and there is no evidence of a slough. A few goblet cells are present in the mucosa. The basement-membrane beneath the epithelium is regular and intact, while in the submucosa beneath this is a very distinct infiltration of lymphocytes and plasma cells (Fig. 1). The muscular wall of the sac does not by any means show a corresponding degree of inflammation. The vessels are, however, somewhat dilated, but they

* Klin. Monatsbl. f. Augenheilk., Festschr. f. Manz, 1902.

do not present the characteristic multiplicity or engorgement which one would anticipate in a section removed from the neighborhood of the nasal duct.

CASE 2.—M. L., a Hebrew, aged thirty-seven years, a cabinet-maker by trade, was also seen by me at the Royal Victoria Hospital. He complained of his eyes watering for years and that he was not able to obtain any relief from the trouble. He stated that he had never suffered from any inflammatory disturbance in or about the eyes, and that pain and tenderness had never been associated with the region of the lacrimal sac. As in the former case, the canaliculus had not been slit and the use of probes had never been resorted to. A diagnosis of lacrimal obstruction was made by means of the lacrimal syringe. A nasal examination showed a condition of deviation of the septum to the right side, the opposite to the affected tear-sac, with a moderate degree of chronic rhinitis. As in the former case, there was no apparent hypertrophy in the tissues about the lower end of the nasal duct, and there was no nasal discharge at all suggestive of suppurative changes in the accessory nasal cavities. The patient was myopic, but normal vision could be obtained by means of correcting lenses; these, however, he had not been in the habit of wearing.

A radical extirpation of the sac was attempted as a relief for the epiphora under ether anesthesia. The sac was exposed without difficulty, but shortly before excising it at its upper and lower attachments a small cut was accidentally made in the sac-wall with the scalpel. Through this opening protruded a polyp of a pearl-gray color, very much of the same color as one observes in the nasal form of polyp, and of about the size of an ordinary pea. It was perfectly round, and in shape, size, and color it very much resembled an ordinary pearl of moderate size. Unfortunately, during the subsequent dissection the polyp broke off from the pedicle, but it was procured and placed in formalin for subsequent pathologic investigation. When the sac was completely removed, a larger opening was made in the sac-wall, which revealed a second polyp attached to the nasal side of the sac-wall. This tumor was somewhat hammer or anvil-shaped, the pedicle being comparatively

short but stout. The polyp was of the same color and size as the one which had broken away, almost filling the sac horizontally, though not vertically. The sac was not ectatic nor were its walls unusually thick. The specimen was fixed in formalin, hardened in progressive strengths of alcohol, and imbedded in celloidin.

Microscopic sections of the polyp show it to consist of a delicate stroma of cells somewhat resembling areolar tissue but not absolutely comparable to any of the recognized tissue cells. The individual cells are rather large, stellate, and give off a number of delicate processes, the individual cells being separated from one another by a matrix which by staining with thionin is shown to contain varying amounts of mucin. Scattered through this matrix one sees a number of blood-vessels with unusually thin walls. Throughout the matrix one is also able to discern a definite number of lymphocytes. That the tumor can hardly be regarded as a true myxoma but one more or less combined with fibrous-tissue elements, is substantiated by an examination of the pedicle of the mass (Fig. 2). This is formed very largely of connective tissue proper, doubtless an extension of elements of the submucosa of the sac as well as of new connective-tissue cells, the result of previous inflammatory changes. One also notices at this point more than at any other the vascular nature of the tumor, the vessels being larger and their walls more formed than elsewhere in the tumor. The pedicle and that part of the polyp adjacent to it are covered with columnar epithelial cells which disappear from the surface of the polyp as one proceeds farther forward. The definition of these cells is not shown as clearly as in Case 1, their presence being at many points disguised by the degree of infiltration which involves the mucosa as well as the submucosa. These cells, however, do not appear to be thrown off at any point, and nothing at all suggestive of a slough or of actual necrosis is to be distinguished, the condition appearing more as one of strangulation or of an intense edema. Staining sections by Gram's method did not reveal the presence of micro-organisms.

From an examination of these two cases I have come to the conclusion that polyps of the tear-sac, as in the nose and ac-

cessory nasal cavities, are evidences of hyperplastic growth or actual tumor formation which may possibly be due to a pre-existing inflammation, as Adami* has pointed out. This inflammation, I might add, is not necessarily of an infective or suppurative type. If we are to regard polyps as composed morphologically of the identical tissue cells constituting the mucous membrane, besides the additional cellular composition of the polyp, one would, as in the nose, expect to find inclusions of glandular elements which may at times become dilated owing to a retention of secretion resulting in the formation of cystic tumors. That glandular elements are not shown in the sections which I have prepared and described is not at all surprising. Hertel has made the statement that the normal lacrimal sac is supplied with glands in its mucosa, but from the cases which I have had the opportunity of examining microscopically I have been able to satisfy myself that a true gland existed in only one case. If present, they are, in my opinion, exceedingly rare, and consequently their presence in the sections which I have reported would hardly be anticipated as frequently as in nasal polyps.

It is interesting to note clinically how inefficacious the passage of probes would have been with such polypoidal excrescences with a pediculated lateral attachment to the sac mucosa; their recurrence would have been inevitable. It is further of interest to suggest that the primary etiologic factor in these two cases has not been trauma, as Wagenmann suspected in his case, but rather a possible indefinite or chronic thickening of the nasal mucosa. This is one of many forms, as Heilmaier† has pointed out from an exhaustive examination of cases of dacryocystitis, which may be responsible for 65 per cent. of the total number, involving the subperiosteal plexus of veins about the nasal duct and inducing evidence of strangulation or of edematous changes in the mucosa and submucosa of the sac.

* Principles of Pathology, vol. ii, p. 269.
† Zeitschr. f. Augenheilk., vi, S. 540.

A CASE OF ACUTE SUPPURATIVE DACRYO-ADENITIS.

W. GORDON M. BYERS, M.D.,
Montreal, Canada.

The patient, a young woman, aged twenty-five, whom I had treated twenty-nine months previously for marginal blepharitis and chronic catarrhal conjunctivitis, came to me on February 19, 1906, complaining of a feeling of fullness in the outer part of the right eye with tenderness on pressure over that area. The condition had begun four days before she consulted me, with a sensation inside the lids as if an eyelash had been displaced. Up to this time her general condition had been good in every respect, and she could give no cause for her trouble.

From slight swelling of the outer part of the upper lid, and slight fullness and redness of the upper outer part of the fornix, the condition rapidly developed all the signs of an acute suppurative dacryoadenitis, the swollen gland being distinctly palpable and the temperature slightly raised (99°–99.8°).

On February 23, when, judging by palpation, there seemed to be softening within the gland, I punctured the lid over the swelling and withdrew some pus for microscopic examination, after scrupulously sterilizing the surface of the skin.

This procedure was followed by a rather sharp reaction, and on February 25 by the discharge of a small amount of thickish pus from a point in the upper fornix situated about midway between the outer surface of the globe and the outer margin of the orbit. From this time on the symptoms gradually subsided, and disappeared entirely about a month after the beginning of the inflammation.

The matter withdrawn hypodermically was examined and worked out for me by Dr. Oskar Klotz, at the time assistant pathologist to the Royal Victoria Hospital, now professor of pathology in the University of Pittsburgh, who returned the following report:

Pus from the original matter showed organisms present as diplococci, staining positively to Gram's. No other bacteria present. On culture-media: Agar, growth thin and whitish, with yellow borders, developing after several days; blood-serum-agar, growth similar to pure agar, but color more pronounced and media not liquefied: gelatin, slow liquefaction of media; milk, acid produced, then decolorized; potato, growth thin, a grayish-yellow sulphur color developing after several days; broth, cloudy, no scum; blood-serum, growths similar to agar, no liquefaction. Smears made from the agar cultures show the organisms to be in staphylococci, from the broth cultures in diplococci, arrangement. Diagnosis, micrococcus hæmorrhagicus.

The chief interest in this case lies in the finding of the micrococcus hæmorrhagicus in pure culture. There is, however, another point in connection with the bacteriologic reports that is worthy of note. A week after the spontaneous rupture of the gland Dr. Klotz made an examination of the conjunctival sac of the affected side, but found only the staphylococcus pyogenes aureus. This apparent inconsistency may, perhaps, in reality be regarded as proof of the view that has come to be held in regard to the micrococcus hæmorrhagicus since this work was done; namely, that it is, in fact, merely a variant of the staphylococcus pyogenes group. In other words, in this case the micrococcus hæmorrhagicus may have been only a form of the staphylococcus pyogenes aureus which took on more virulent and special characters during the active stages of the adenitis, and returned to its original state after the subsidence of the acute symptoms.

A CASE OF BITEMPORAL HEMIANOPSIA WITH ACROMEGALY AND OTHER SYMPTOMS APPARENTLY DUE TO DISEASE IN THE PITUITARY REGION.

Diagnosis Confirmed by Autopsy.

S. D. RISLEY, M.D.,
Philadelphia.

The following case history was presented by request before the Philadelphia Neurological Society in November, 1910, and subsequently published in the Annals of Ophthalmology, January, 1912. The history is now repeated in brief as published, the reason for doing so being that opportunity was afforded for confirmation by autopsy, through the somewhat sudden death of the patient from an intercurrent lobar pneumonia.

On October 10, 1910, Dr. Walter L. Pyle kindly sent to me for consultation Mrs. X, aged sixty-five, who had come under his care as consultant about two years before. She had received glasses from another ophthalmic surgeon to correct a hypermetropic astigmatism, and at that time is reported to have had normal sharpness of sight. There is no record of any impairment of her general health. She states that just before consulting Dr. Pyle she first noticed great difficulty in finding the lines of print when reading, a difficulty which has steadily increased. Dr. Pyle found reduced central vision and a "concentric contraction of the fields of both eyes," but more advanced in the left. Unfortunately these fields of vision have not been preserved.

At that time she was seen in consultation by Dr. Hobart A. Hare, who admitted her to the Jefferson Hospital, took her blood count and blood pressure, and it seems regarded

the case as one of anemia, for which she was treated, but without improvement of the visual conditions.

The woman is the mother of four children, two of whom are now grown healthy men; the other two were healthy at birth, but died, one at eleven months, the other at two and a half years. She says her health has always been good and she regards it as good now, and says that she has never had any serious illness.

Notwithstanding this history, she has now an old, ivory-like pallor, but no hardness or rigidity of her tissues, as in myxedema. The thyroid glands are apparently normal. She has increased rapidly in weight during the last year and a half, but is not obese. Although not a large person, she now weighs 171 pounds, a somewhat surprising weight for one of her height. She says the increased weight seems to be about her waist and hips, and she has a massive torso. Her arms and lower extremities are those of a person of slender frame. Compared with the size of the arms and legs, the hands, and especially the feet, are large and particularly massive. The finger-ends are not clubbed, but the nails are creased and hard. There are no gouty concretions. The anterior portion of the skull seems large and out of proportion to her neck and the posterior part of her head. The under jaw is large, but not projecting, and the face, nose, and glabellum large, giving to the face a mask-like appearance. Unfortunately, for the sake of comparison, she has had no photograph taken for many years. The lips are thick, purplish in color, and the mouth, when the lips are closed, is a straight horizontal line. The tongue is bluish and large, but possibly not abnormally so, and is not indented by the teeth. The patellar reflexes are absent. The sinuses in anterior part of the skull are translucent, and the frontal sinuses and antrum very large. The heart and general circulation are normal, and the urine shows neither albumen nor sugar. The husband asked the cause of his wife's drowsiness, and inquiry revealed the fact that no sooner does she sit down than she falls asleep; even while talking becomes heavy eyed, sluggish, and has often gone to sleep even while eating. She has constant annoyance from an itching over her entire body. Her sense of smell is lost.

The contraction of the fields of vision steadily advanced

until, when seen by me on October 10, 1910, there was complete bitemporal hemianopsia (Fig. 1), all perception of light by the nasal half of the retina in both eyes being lost up to or near the point of fixation in the right eye and advanced slightly beyond it in the left. In the left eye there is no perception for colors, and there is also a paracentral scotoma, triangular in shape, and situated above the fixation point well within the retained area of vision. The Wernicke pupillary inaction was absolute in both eyes; there was no oculomotor palsy. The retinal arteries were small, the veins normal.

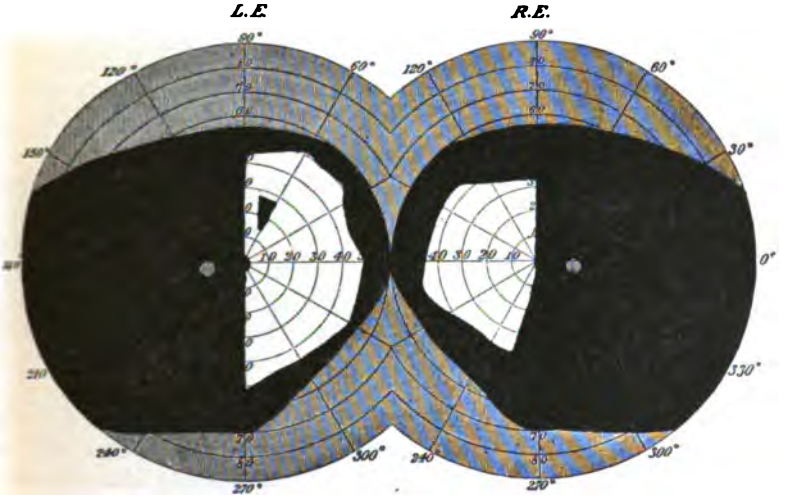

Fig. 1.—Bitemporal hemianopsia with acromegaly.

There was some retinal striation near the disc, above and below, along the course of the vessels, and the nasal half of both optic nerves was gray and distinctly paler in color than the temporal. The bitemporal hemianopsia pointing to disease in the region of the chiasm, she was sent to Dr. William M. Sweet for *x*-ray study, with the request that he use especial care to discover the presence of a tumor in the pituitary region or any abnormal condition of the sphenoidal or other sinuses, and if possible to determine the presence of any enlargement or notable change of the lesser wings of the sphenoid bone. These studies having been made, I then

requested Dr. Charles K. Mills to make a careful study of her condition from the standpoint of neurology. I received the following communication from Dr. Sweet: "My Dear Dr. Risley: Dr. Manges has, at my request, made Roentgen plates of Mrs. X for study with the stereoscope, and careful comparison of these plates with the same region of the head in health shows an unusual enlargement of the bony structures of the sphenoid bone. In the plates the anterior and posterior clinoid processes bend toward each other, forming a nearly complete foramen, both on the left and the right side. These deviations may be in the nature of a hypertrophy of the bone, with the possibility of a similar change in the soft parts, in which case there would be sufficient pressure for the symptoms manifested."

Dr. Mills furnished me the following memorandum: "Her appearance is peculiar: the face has somewhat the appearance of leontiasis ossium—at least it looks broad and is somewhat enlarged. The torso is very large, as are also her hands and feet, especially the latter. The case at least appears to be one of acromegaly, or some form of abnormal increase of the tissues. Knee-jerks are both lost; ankle-jerks are both lost. Otherwise patient has few demonstrable objective symptoms. Case is probably one of disease of the pituitary."

In December, 1911, and again in February, 1912, Dr. Pyle reported no notable change in her condition, either general or local. In March, 1912, the patient died somewhat suddenly from an intercurrent attack of lobar pneumonia. I am indebted to Dr. David Riesman for an elaborate outline of the general autopsy, in which, however, there is nothing of special interest except possibly the fact that "the right adrenal was small, soft in the center, surrounded by fat," until we come to the results of the examination of the brain, where the statement is made, "the scalp is thicker than normal, the skull saws with ease, but shows nothing abnormal except that the venous marking is more prominent than usual; the dura is normal. In the anterior fossa in front of the sella turcica the floor of the

skull is raised in an irregular manner in an area the size of a small walnut; the bone here is thin, porous, and dark in color. When chiseled away, the posterior ethmoidal cells are found to contain a large amount of thin, yellowish, purulent material. At the base of the brain there is a large tumor measuring 5 cm. in length, 5 cm. in width, and 3.6 cm. in thickness. It is oval in shape and rests on the frontal lobes anterior to the optic chiasm and compresses the optic nerves; a number of large vessels enter it. It makes a distinct concavity in the mesial aspect of the frontal lobes. Lying in front of the chiasm, it is separated from the latter by a space of about ½ cm. in width. On the lower surface of the tumor, near its middle, is a smooth, cup-shaped depression, 2 x 2½ cm. in depth, caused by the projecting posterior ethmoidal cells. The tumor was encapsulated, finely nodular on the surface, and the capsule very vascular. The mass seemed to have entirely replaced the pituitary body. The brain otherwise showed nothing abnormal. The tumor on examination proved to be a highly vascular spindle-cell sarcoma. In the sections made no trace of the pituitary body was found."

DISCUSSION.

DR. HOWARD F. HANSELL, Philadelphia: Dr. Risley mentions drowsiness as one of the symptoms of his patient. Some years ago I described the case of a man in whom the diagnosis of tumor of the pituitary body was made, and later confirmed by autopsy. He had advancing atrophy of the optic nerve without well-marked hemianopsia. The most striking symptom, apart from his loss of vision, was drowsiness; he slept for a period of several months for nearly twenty-two hours out of each day. In most of the reported cases drowsiness has not been prominently mentioned by the writers, and in this respect Dr. Risley's case and mine are exceptional.

DR. WILLIAM K. ROGERS, Columbus: The subject is one of a great deal of interest, and a great deal remains to

be done before these lesions and their manifestations will be definitely formulated. I would like to call the attention of the Society to an interesting group of phenomena, in a case I have had under observation for the past two years. A boy between fourteen and sixteen years of age, in whom the diagnosis of acromegaly had been made and in whom the symptoms of drowsiness and severe headaches are prominent, presents a varying degree of choked discs with no material alteration in the visual fields. The elevation of the optic papillæ varies from +1.5 D. on some occasions to +9 D. on others, with a little corresponding variation in refraction, which is considerably hypermetropic and unequal, the more defective eye being slightly amblyopic while acuteness is normal in the other. The headaches and drowsiness are commensurate with the swelling of the discs, suggesting that these phenomena are directly dependent upon a varying pressure of subarachnoidean fluid. More or less definite response to thyroid medication, however, would tend to confirm the diagnosis of fundamental pituitary disease.

DR. JOHN E. WEEKS, New York: The findings in the autopsy in this case do not make it apparent that the tumor was one of the pituitary body. The tumor was found anterior to the chiasm instead of posterior, and was of very large size. Though the fields are such as we find in enlargement of the pituitary body, the anatomic findings, as I understand them, do not bear out this theory. I have recently had a case of bitemporal hemianopsia not accompanied by pronounced acromegaly, but there was at one time some myxedema. The patient was under observation a number of years, and went to Baltimore on my advice. Dr. Cushing, after studying the case thoroughly, operated and removed a portion of a much enlarged pituitary body. The result was that the field of vision in one eye returned almost to normal; the field in the other eye was not much influenced, but vision improved. At the present time the patient is in excellent health. In this case an *x*-ray skiagraph was taken, and the posterior clinoid processes were shown to have been absorbed. I think that this is generally the case in conditions where the pituitary body is much enlarged. In the case Dr. Risley reports the clinoid processes were present, which would indicate an anomalous condition

or the presence of a growth that was not due to great enlargement of the pituitary body.

DR. EDWARD JACKSON, Denver: Within a few months I have seen a case of bitemporal hemianopsia where there was absence of any symptoms of pituitary disease and absence of any discoverable lesion of accessory sinuses of the nose, in which a careful study of the case by a neurologist resulted in diagnosis of arsenical poisoning. There was also considerable optic atrophy. Last year Professor Fuchs, in his paper on tabetic optic atrophy, referred to a small group of cases in which bitemporal hemianopsia was quite pronounced. It was the form of limitation of the fields of vision. While the symptoms must and should suggest pituitary disease, there must be a certain number of cases that arise from other causes that are still more obscure. The subject still requires the report of all cases that have been thoroughly studied.

DR. THOMAS B. HOLLOWAY, Philadelphia: It seems to me that one of the most interesting factors in Dr. Risley's case is the location of the growth. I have recently had occasion to partially cover the literature on this subject, and, according to Bartels, but three cases were found anterior to the chiasm among the 39 cases of growths of the pituitary body to which he has referred. Dr. Risley's is the fifth that I know of. I referred, at the recent meeting of the American Medical Association, to the constriction of the optic nerves brought about by the anterior cerebral arteries, if the growth is large enough to bring about sufficient pressure. This constriction of some portion of the visual tract must be considered as having some influence on the fields of vision. Another possibility is the occurrence of cysts; thus, in Bartels' case, there was a large cyst which practically formed the floor of the third ventricle, and it was supposed that its evacuation into the third ventricle was responsible for an increase in the visual acuity of the patient. Erdheim has cited an analogous case with autopsy findings, and other possible cases are those of Wood and of Shoemaker of St. Louis.

DR. WILLIAM ZENTMAYER, Philadelphia: In connection with the point that Dr. Holloway brought forward of improvement of vision that takes place in some of these

cases, I had a case of bitemporal hemianopsia under observation for nineteen years. For seventeen years the field remained unchanged, and vision constantly equaled $\frac{5}{15}$. At the end of the seventeenth year the field gradually increased in size and finally became merely a concentrically contracted field. In other words the blind halves took on function again. Vision rose from $\frac{5}{15}$ to $\frac{5}{7\frac{1}{2}}$. The patient had all the signs of acromegaly. Unfortunately, at death, no postmortem could be obtained. Therefore, we do not know the nature of the lesion, but only that she had this remarkable recovery of vision after seventeen years.

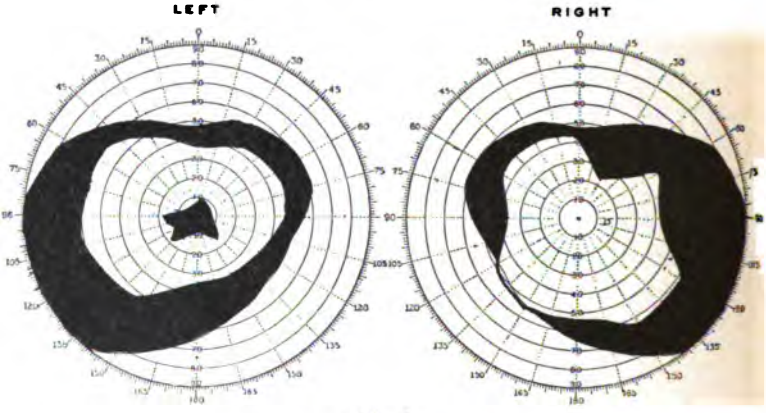

Fig. 1.

DR. WALTER R. PARKER, Detroit: I now have under observation a case of pituitary disease or tumor, showing failure of vision, temporal hemianopsia, and absence of the posterior clinoidal processes of the sella turcica, in which I was fortunate enough to get records of fields undergoing rapid changes.

The first field taken (Fig. 1) showed a right temporal contraction of the form field to 45 degrees, and a nasal contraction to 40 degrees. While the fields for blue and red were markedly contracted the field for green was nearly obliterated. Vision equals $\frac{6}{9}$.

The left field was generally contracted to 60 degrees

temporally and down, and to 35 degrees to 40 degrees nasally and up, with a central scotoma somewhat irregular in shape including the area between the disc and macula. Vision equals $\frac{3}{60}$.

The field that was taken three weeks later showed in the right eye a temporal contraction to 30 degrees and a relative scotoma up and out to 20 degrees. The left eye showed an entire absence of the temporal field and a slight nasal contraction. Six months later the right field was contracted temporally to 20 degrees, except for a segment at 120 degrees which extended to 70 degrees, and a smaller relative scotoma. The nasal field was more nearly normal. In the left eye the temporal field, which was entirely absent at the last examination, showed a large relative scotoma somewhat oval in form.

During the past six months the patient has had inunctions of mercury, although the Wassermann gave a negative result. How complete the recovery will be I am unable to say.

DR. WILLIAM EVANS BRUNER, Cleveland: In connection with the case of Dr. Risley's it might be of interest to the members to see a radiograph of a recent case of supposed tumor of the pituitary body. The patient, a young man, aged twenty-two, consulted me in March, 1911, for failure of vision beginning in the left eye, and several months later involving also the right. The left eye is now almost blind, having only light perception on the nasal side, while the right eye has a vision of $\frac{6}{45}$ and almost complete temporal hemianopsia. The ophthalmoscope shows optic atrophy marked in the left eye and less in the right. Other than headaches, the neurologic examination was negative, as was also the examination of the nose and sinuses. Occasionally there has apparently been an excessive secretion of urine. This equaled 1265 c.c. in twenty-four hours while he was in the hospital, had a specific gravity of 1024, and showed no sugar. Blood examination was negative except that the hemoglobin was rather low (86%). The Wassermann reaction and the von Pirquet test were negative. The *x*-ray clearly shows marked absorption of bone in the region of the sella turcica. This was thought most probably to be due to a tumor of the pituitary body. For comparison with this

I pass around another *x*-ray plate of a normal head. The patient would not consent to any operation since we could not promise him, at such a late stage of the optic atrophy, that it would help his vision, and we are still waiting for other opportunities to confirm the diagnosis.

DR. SAMUEL D. RISLEY, Philadelphia: There were a number of factors in this case which I think might wisely be emphasized. In the first place, with this serious tumor at the base of her brain the patient regarded herself in perfect health. She never had any headache. She had only the drowsiness and acromegalic group of symptoms. It is interesting also to note that, although careful study had been made again and again of the sinuses contiguous to the orbit and of the nasal fossa, no one even suspected the purulent condition of the posterior ethmoidal cells shown by the autopsy.

AMBLYOPIA FROM INHALATION OF METHYL ALCOHOL.

HENRY H. TYSON, M.D.,
New York.

Although thirteen cases of methyl alcohol amblyopia from inhalation have been reported in the literature, they are not so common that a report of three additional cases may not be of some interest, as it may help to recall attention anew to its toxicity, and especially on account of the interesting visual fields, as I found no similar fields recorded. Of the thirteen reported cases (eleven by Buller and Wood* and two recently by Gruening), eight were varnishers using shellac dissolved in wood alcohol, and the cases in the following report come under the same classification.

CASE 1.—Mr. G. K., aged twenty-one, painter and varnisher. No history of syphilis, rheumatism, tuberculosis, or

* Trans. Sect. on Ophthal., Amer. Med. Assoc., 1904, p. 412.

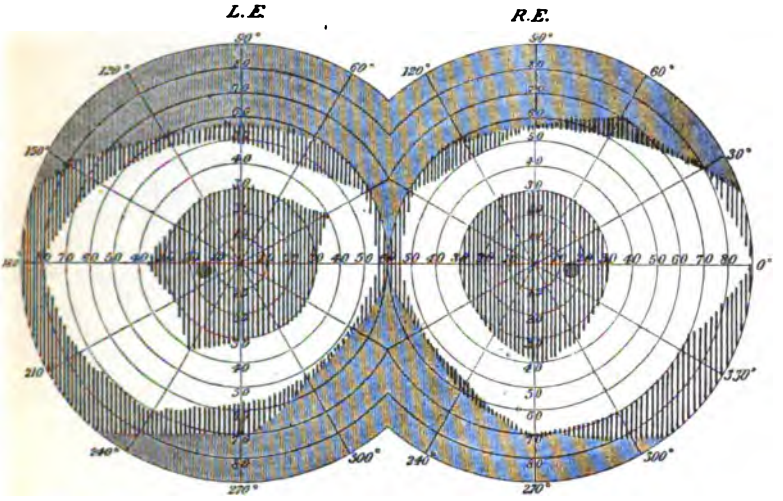

Fig. 1.—Field for white. 10 mm. square. Colors not recognized.

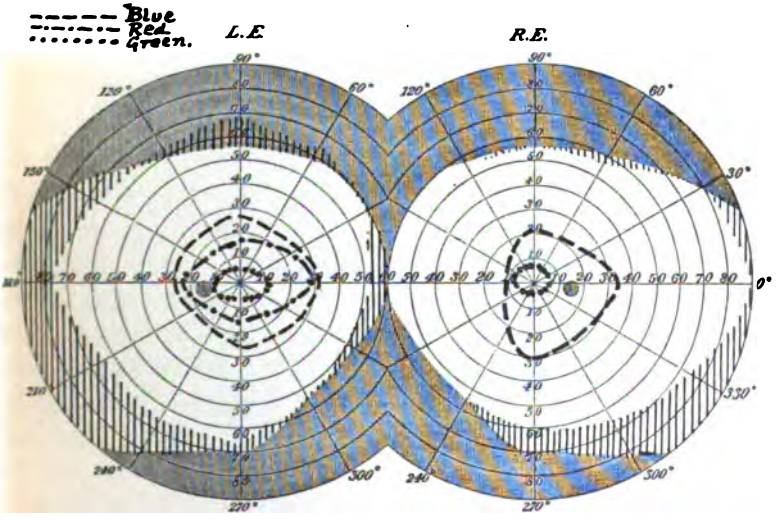

Fig. 2.—Color fields. Right eye, red and green contracted to 5°.

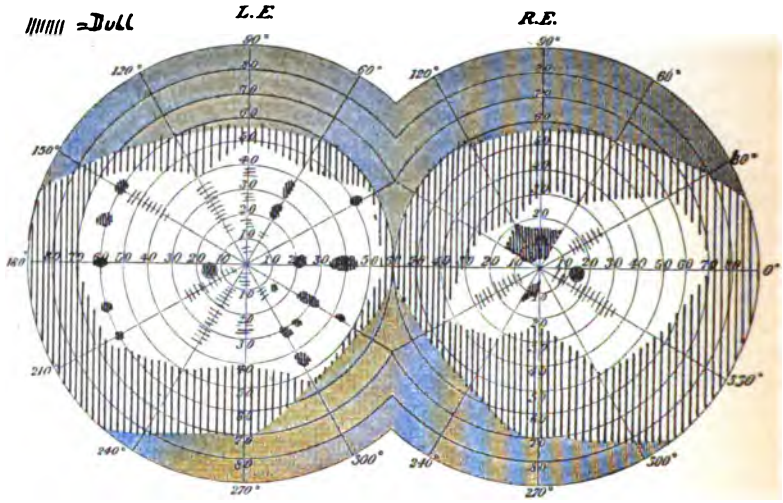

Fig. 3.—Fields for white.

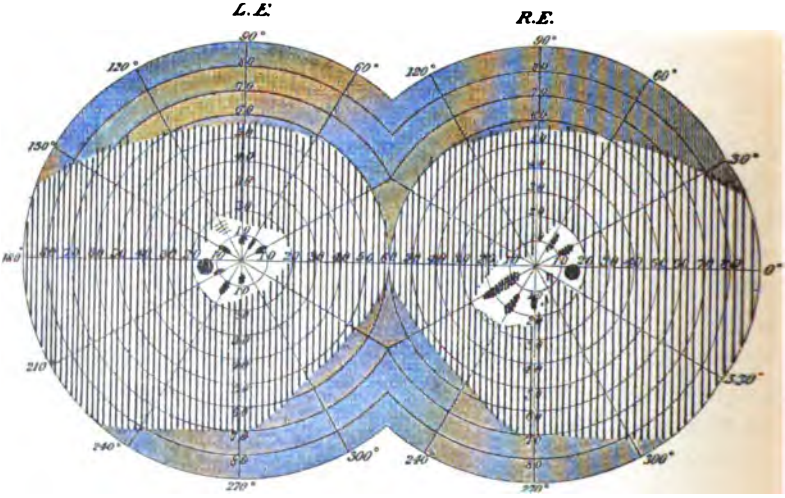

Fig. 4.—Fields for green. 5 mm. square test object.

nasal disease; does not drink whisky, but smokes cigarettes in moderation. He was employed on Dec. 3 and 4, 1911, shellacking the interior of a large beer-vat. He wore gloves while at work. On Dec. 5th he complained of headache, vertigo, unsteady gait, and acted as if intoxicated, with nausea and vomiting, and was unable to work. On Dec. 7 vision commenced to fail, and he consulted his family physician, who made a diagnosis of methyl alcohol poisoning and prescribed laxatives. His vision continued to fail, and he was advised to consult an oculist, and visited the clinic of the New York Ophthalmic and Aural Institute on Dec. 12, 1911. Examination: Vision (eccentric), R.E. = $\frac{1}{200}$; L.E. = $\frac{2}{200}$, counting fingers when held in the extreme inferior temporal fields. The pupils were widely dilated, with practically no reaction to light or convergence; the eyes were painful on rotation and to pressure backward, and fundi showed optic neuritis, with dilated dark veins, arteries darker than normal, but not altered in size, with extensive retinal edema, especially marked along the vessels. There was some cyanosis, with papular eruption on face and chest.

He was admitted to the hospital on the same day; pilocarpin sweats, calomel and jalap as purgatives, with strychnin and oxygen were prescribed. Blood examination by Dr. F. Shook showed r.b.c., 5,265,000; w.b.c., 8000; hemoglobin, 106%; urine normal. He remained in the hospital eight days. On Dec. 19th, V.R.E. = $\frac{1}{200}$; L.E. = $\frac{3}{200}$, with absolute central scotomata extending 30° about fixation point in all directions; colors not recognized, and his field for white was contracted about 10° (Fig. 1). Strychnin was continued with kali. iodid. Two weeks later, Jan. 3, 1912, his central vision showed remarkable improvement to $\frac{1}{10}$ in each eye. No central scotomata could be discovered by perimetric or Bjerrum test. White fields were about normal; color fields as shown in Fig. 2. The fundi showed the retinal arteries contracted, veins dark, with pallor of the discs, and the edges still swollen and blurred. On March

21, 1912, V. = $\frac{15}{20}$. Visual fields as shown in Figs. 3 and 4. In the left eye the field for green was about the same as the last test, excepting that the field was larger and had many small scotomata scattered throughout which were not confluent. The visual field for white in the right eye was irregularly contracted, with large and small scotomata on various meridians, especially near the fixation point above and below.

On April 4th his vision was $\frac{20}{30}$, with color fields as shown

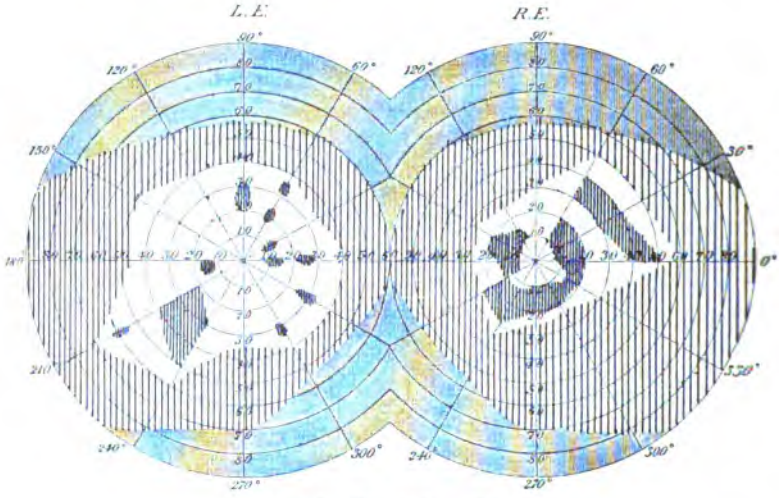

Fig. 5.—Fields for white.

in Fig. 5. The red and green fields were contracted to 5° in both eyes. The field for white in the right eye was irregularly contracted, with irregular ring scotomata encroaching to within 10° of fixation, and another rectangular shaped scotoma extending from meridian 0° to 60°. In the left eye the field for white was slightly more contracted than at the last examination, with large and small scotomata. On June 4th the vision was $\frac{20}{30}$ + in each eye, with effort at fixing; refraction was normal, and visual fields were still continuing

to contract (Fig. 6). In his right eye there was nasal contraction, with large quadrantal defect in the temporal field for white, with scotomata on parallel 10°. In his left eye there was irregular contraction of the field for white, with scotomata on 10° and 15° parallels. The color fields for red and green were contracted to 5° about fixation in both eyes. Fundi showed bluish white nerves, whiter on temporal sides, with evidence of beginning excavation; the arteries were slightly contracted, with veins of normal size. He com-

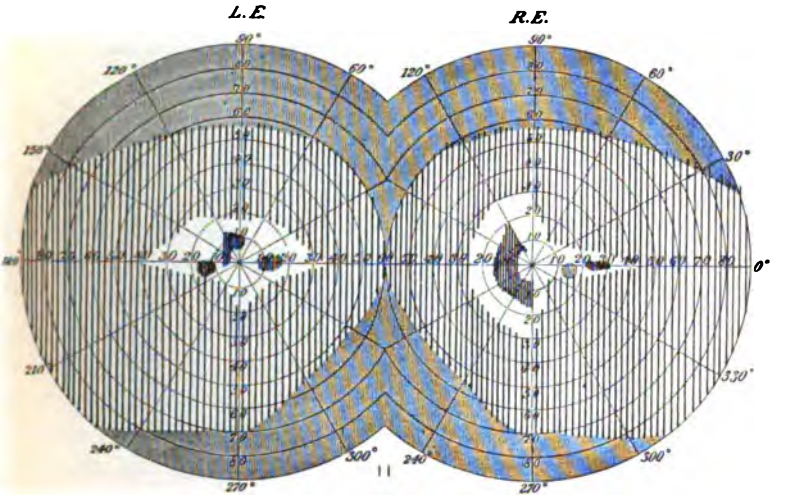

Fig. 6.—Fields for white.

plained of difficulty in seeing well in a dimly lighted room, and requires quite a long time to adapt his vision in going from a light to a moderately dark room; he also cannot see to play ball (due to his contracted fields). While his hearing was a trifle dull at first, it improved with his visual acuity, but he states that of late it is failing. Unfortunately, no careful tests were made of his hearing at the first examination, but I am of the opinion that the function of many of the cranial nerves besides the optic is affected to some

extent by methyl alcohol poisoning, and would suggest that in the future more attention be given to searching for these suspected defects in examining these cases.

In this connection it is of interest to note that two of his fellow-laborers who were employed on the same work, but who had labored three days each during the same period, one died suddenly forty-eight hours and the other seventy-two hours after stopping work; also that at the same brewery during last year, with a similar lot of varnish, five laborers died with symptoms of methyl alcohol poisoning. After these deaths other varnish made with grain alcohol was used, and the wood alcohol preparation was stored in the brewery until its use in 1911.

There is also a case pending in the courts in a large city in the northern part of New York State, where, under circumstances quite similar to the case just reported, one varnisher died and another was made blind, having only light perception remaining, due to methyl alcohol poisoning.

It is customary for the workmen varnishing the interior of beer-vats to work thirty minutes, and then to come out into the open air for thirty minutes, working every alternate half hour, and while at work they are usually supplied with fresh air pumped into the vat. In Case 1 no fresh air was supplied while he was at work in the interior of the vat, whether it was because they were using a new electric heater instead of a charcoal burner, formerly used, and fresh air was not thought necessary under the circumstances, or on account of the expense for the installation of a fresh-air pump, I am unable to state. Consequently there was no ventilation in the interior of the vat, as the only openings into it were small pipe-holes in the top, and one about large enough to permit the workman to crawl through into the interior.

Denatured alcohol is cheaper than methyl alcohol, but the latter is used because it "cuts" or dissolves the shellac

quicker, constituting a saving of from five to eight hours in time, and, as in this strenuous age the employers apparently prefer *time savers to life savers*, especially as it is difficult to get damages or a conviction under the present laws, they appear willing to take a chance with the courts.

Two additional cases of amblyopia from inhalation of methyl alcohol, which have recently come under my observation and have never been reported, are as follows:

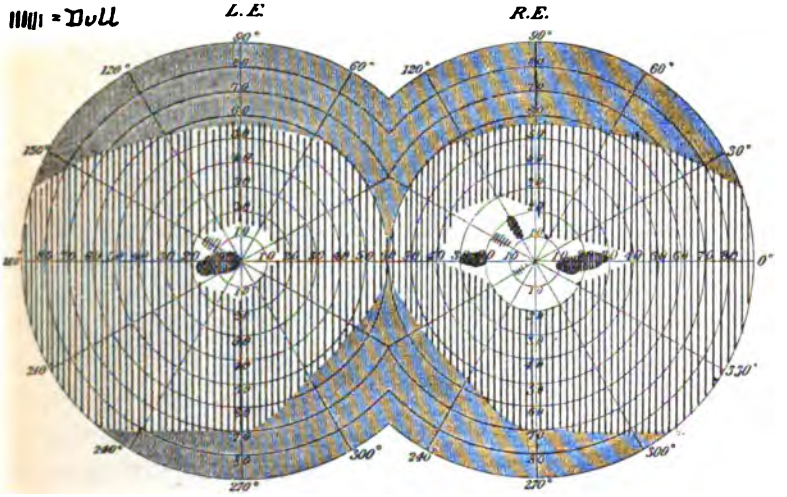

Fig. 7.—Fields for white.

CASE 2.—Miss E. W., aged thirty years, works at polishing lead-pencils and uses varnish made from wood alcohol. Was a former patient with vision $\frac{20}{30}$ with error of refraction corrected. The history is negative as to syphilis, tuberculosis, or nasal discharges. On April 13, 1912, she consulted me about an attack of headache, with vertigo, weakness, nausea, but no vomiting; also had dizziness and obscuration of vision while working, and thought her glasses required changing. V.R.E. = $\frac{20}{70}+$, with -1 cyl. axis $90° = \frac{20}{50}$; L.E. = $\frac{20}{200}$, with -1.25 cyl. axis $90° = \frac{20}{70}$. Relative central scotomata for red and green with color fields

for green contracted to 5° and for red to 10° in both eyes; also irregularly contracted fields for white and form, and an enlarged horizontally oval blind spot in the right eye, extending from near fixation to 20 T. and a scotoma on 150° meridian from 10° to 20° parallel. In the left eye an enlarged horizontally oval blind spot from 5° to 30° T., with scotomata on various meridians (Fig. 7). Upon questioning she stated that the group of symptoms mentioned came on principally during the day, when the windows were not open (cold or damp days especially). That she worked from 7 A. M. to 12 M., with half an hour for lunch, and then from 12.30 to 5.30 P. M. After working about three hours the color of the pencils began to vary, the vision to blur, and then the pencils became invisible, accompanied by the general symptoms mentioned. After going into the open air for half an hour, vision returned, and, feeling better, she would resume work until lunch time. The same condition recurred in the afternoon. This group of symptoms is not experienced at any other time, except while at work, as on Sundays or holidays she is never ill. During days when plenty of fresh air is supplied she does not experience any of these symptoms. The optic discs were hyperemic, the edges blurred, and the veins dilated, and a diagnosis of chronic methyl alcohol amblyopia was made.

Under fresh-air treatment, kali. iodid, and strychnin, the general health was better, and vision improved slightly to $\frac{20}{50}$; the fields and scotomata remained unchanged. Has been working one year at her trade, and for the first six months noticed these symptoms occasionally, but more frequently of late. The room in which she works is about 20 x 50 feet, with several windows—enough, I suppose, to comply with the law; but of what practical use are the windows if they are not allowed to remain open during damp or cold weather? The reason given for not opening them at these times is because the pencils do not take on a good polish. About twenty-five to thirty young women work in this room and take turns in going out into the fresh air. All have headaches, and numbers have been treated for gastric disorders.

One was absent about eight weeks from work on account of chronic gastritis, and one other suffered from poor vision, and was informed by her physician that it was due to working with wood alcohol varnish. It is a fact that those workers who are stationed near the windows experience less toxic disturbances than those who work remote therefrom.

On June 9, 1912, she reported that about three weeks previously she had had double vision, associated with headache and loss of appetite. *Status præsens:* Paresis of left internal rectus. V.R.E. = $\frac{20}{100}$; L.E. = $\frac{20}{200}$. She had enlarged blind spots, with central scotomata for red and green; the optic discs were hyperemic, the edges blurred, centers edematous, and veins dark blue. She has used the methyl alcohol to bathe head for headache while at work, and also to wash her hands to remove the shellac at times when in a hurry instead of washing them with water. She states also that this was a common custom with all the workers, and that she did not know that it was injurious. She said that her urine varied greatly in color, at times being very dark while at others very light. In this connection it would be interesting to have microscopic examinations of urine made in all these cases to determine whether any constituents of the hemoglobin are exereted, as, judging from the clinical symptoms, it is possible that hematin may play some rôle as a causative factor in producing some of the general symptoms. Frequent blood tests and urine analyses made early during the disorder would help to confirm or disprove this supposition.

CASE 3.—Miss L. K., aged twenty-six years, examined on April 13, 1912. She works in the same room near Case 2. Called for examination on account of failing vision, and desired glasses.

R.E. = $\frac{20}{30}$ + .50s. − 2.50c. axis 80° = $\frac{20}{30}$; L.E. = $\frac{20}{100}$ − 2s. − 1.50c. axis 15° = $\frac{20}{70}$.

The color fields were contracted for green to 5° and for red

to 10° in both eyes, with irregular contracted fields for white and form (Fig. 8). She had a central relative scotoma for green and red, and an enlarged blind spot extending from 20° to 5°, and faint blurring for objects on 300° meridian between 5° to 15° parallel in left eye and on 315° meridian between 10° and 20° parallel right eye. The optic discs in the right eye had temporal pallor with blurring of the superior nasal quadrant. In the left eye nasal pallor with blurring of the temporal quadrant and central edema of the discs, while the veins were dark blue

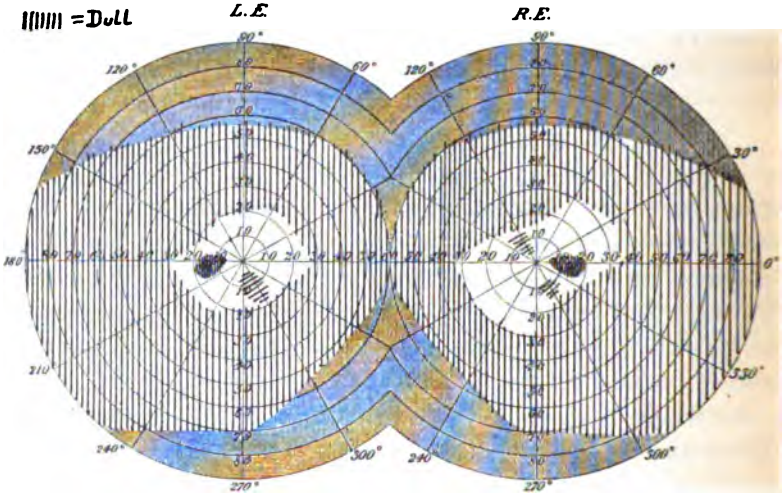

Fig. 8.—Fields for white. Enlarged blind spots.

and dilated. The eyes being painful on rotation or pressing them back into the orbits, the left particularly. Bright light produces photophobia, and she recognizes colors on some days better than on others. The visual acuteness varies; there were no catarrhal conditions in the nose, nor history of syphilis, tuberculosis, or rheumatism. Her general condition improved with kali. iodid, strychnin, and fresh-air treatment, but vision remained the same. She had been under observation only one month, but the history is quite similar to that of Case 2. She commences work at 7 A. M.; at 10 or 11 o'clock frontal headache, dizziness, and

nausea begin; then she rests in the open air for half an hour and feels better; after which she resumes work until luncheon (has one-half hour for luncheon). In two or three hours after returning to work the headache recurs, and usually disappears in the evening some time after stopping work, but is worse on damp days when all windows are closed. The headache is frontal, also has dull pain in behind her eyes; complained of feeling like a cord or band behind and around her eyes, pulling them up into her head. At times she cannot see well on account of a mist before the eyes. The vision returns after going into the open air. Has been working at the trade for four and one-half years, and always has had headache and the sight has deteriorated during that period. She has changed glasses several times with no apparent improvement.

In Case 1 it was interesting to watch the advance of the contraction of the visual fields. The numerous scotomata corresponded to degenerated bundles of fibers and groups of ganglion cells, and indicated from time to time the future limit of the field, as they would become confluent and apparently shut out the field beyond them. Ultimately a tubular field is indicated.

Cases 2 and 3 show that, with plenty of ventilation, no toxemia resulted, while lack of ventilation produced toxic manifestations. While Case 1 is one purely produced by inhalation, and Cases 2 and 3 probably so, yet there may be some doubt in the latter on account of alcohol having been used on the skin for cleansing and bathing purposes, but when the histories are considered, they point to inhalation as the cause.

While the cases which have died from methyl alcohol poisoning have apparently died of respiratory paralysis, and autopsies have revealed an edema of the brain, it is unfortunate that no microscopic examinations have been made of the eyes or nervous tissues. For the eye pathology we are dependent upon the researches made upon rabbits,

chickens, dogs, and monkeys, and the clinical deductions by various observers. The latest researches that I have been able to find in the literature are those of Birch-Hirschfeld in 1902. He used Ehrlich's methylene-blue staining of the neuroglia after Mallory. The optic nerve was stained after Marchi and Weigert. He stated that this series of experiments were made upon monkeys and dogs, and that he found them to be very sensitive to wood alcohol; that they led to the same conclusions as his previous researches; viz., that degenerative changes were noted in the ganglion cells of the retina before any could be seen in the optic nerve; that the changes were spread all over the retina next to some portions which were perfectly normal or slightly affected; that the poison acts directly on the ganglion cells, and the changes in the optic nerve were not secondary to the changes in the ganglion cells; and that the poison acts directly on the nerve-fibers and ganglion cells and not on the interstitial tissue. In Holden's experiments he did not find the optic nerve fibers affected early.

Clinically, conclusions may be deduced according to the variety of the ophthalmological pictures, as the appearance of the fundi varies according to the intensity of the toxicity and the location and resistance of the tissues involved. Cases with no apparent changes in fundi; with dimness of vision, are due to slight toxicity and edema of nervous elements, those with blurred edges of the discs to retrobulbar neuritis, while those with papillary edema were due to optic neuritis, with edema and pressure within cranial cavity. In all these cases, on account of its low resisting power, there is more or less degeneration of the ganglion cell layer of retina. But judging by the enlarged blind spots, with central scotomata and fields of vision with scattered scotomata, which clinically correspond with the microscopic findings of groups of degenerated ganglion cells and nerve-fibers, I am inclined to believe that the loss of function is due

to the affected nerve-fibers first, or at least coincidentally with the ganglion cell layer of retina, as it is more probable to suppose that groups or small bundles of nerve-fibers, so arranged as to be exposed to and damaged by pressure and later by toxins, would be so affected, than it is to have certain groups of ganglion cells selected through chemical affinity or selective action of a poison. In either case the ganglion cell layer being very delicate, the degenerative changes would tend to show microscopically quicker than in the nerve-fibers.

As regards treatment, the only possible hope for preserving or restoring vision is the very early elimination of the poison by inducing evacuation of intestines and stomach, profuse diaphoresis and diuresis, and supporting remedies, as strychnin and oxygen, and I would suggest transfusion in extreme cases.

In conclusion I would emphasize the following facts:

1. That methyl alcohol is a subtle poison and should be recognized as such by law.

2. That it may be inhaled in sufficient quantities during the hours of labor to produce amblyopia, blindness, or even death.

3. That where methyl alcohol is used in the trades and arts, notices of its toxicity should be posted about the premises and an abundance of ventilation should be obligatory. Failure to comply with this law should entail criminal liability. While ventilation will not entirely prevent its poisonous effect, it will greatly minimize it. Whenever sudden dimness of vision or blindness follows gastroenteric attacks, with headache, vertigo, chills, sweating, etc., methyl alcohol poisoning should be suspected.

There are many occupations in which methyl alcohol is used with deleterious effects on the laborers, producing illness and death, and the cause is not suspected. To prevent methyl alcohol posioning in the arts and trades, the substi-

tution of denatured alcohol should be compulsory. It will be only by educating the general practitioner and the public that this subject will ever receive the recognition which it deserves, and it devolves upon the ophthalmologists to exert themselves to their utmost to achieve this desired result.

DISCUSSION.

DR. R. J. CURDY, Kansas City: Two or three years ago the late Dr. Fryer showed a patient before our County Medical Society who had had an attack of amblyopia, having the characteristics of a methyl alcohol amblyopia. The patient had been in the habit of cleaning his tobacco pipe with wood alcohol, and no other cause for the amblyopia could be found, the patient denying all other exposure to alcohol. After several weeks' treatment there was recovery, with only slight impairment of vision. If there is no error of fact as to the source of poisoning in this case, it shows that some individuals are susceptible to poisoning by very small quantities of wood alcohol.

DR. PETER A. CALLAN, New York: The vision in these cases is certainly of interest. In an epidemic in New York in the spring of 1910 I saw five cases in New York Eye and Ear Infirmary from drinking wood alcohol, not from inhalation. I saw three of these cases within five days after imbibing the wood alcohol. One refused to enter, but two became house patients. One was forty-seven years of age, the other twenty-four. The older man at the end of eight days was able to see objects around the ward; the younger man at the end of the fifth day. At the end of three weeks the younger man had V.R.E.$=\frac{20}{20}$; L.E.$=\frac{20}{15}$; the older patient, R.E.$=\frac{20}{30}$; L.E.$=\frac{20}{20}$. At the end of five weeks the vision was fairly the same in both eyes. At the end of four months it fell in both of these cases and has remained what it was at the end of the four months; the elder patient, R.E.$=\frac{20}{100}$; L.E.$=\frac{20}{40}$; the younger, R.E.$=\frac{20}{70}$; L.E.$=\frac{20}{30}$. I mean they can barely pick out the test letters. They can do it by studying them. The peculiar feature in these two cases for the first three weeks after their recovery was the visual fields: they showed inversion of red and green. Green was the larger field, then red; and

after they fully recovered their vision this disappeared, and since then the blue field in both has disappeared.

DR. S. LEWIS ZIEGLER, Philadelphia: Last year I reported a case of methyl alcohol poisoning from imbibition, in which there was no light perception for two months. After the use of negative galvanism extending over a year, vision of $\frac{20}{50}$ and $\frac{20}{70}$ was recovered. In that paper I referred to another patient that I had seen, whose vision had gone down from inhalation alone. It took me some time to find the exact origin of the trouble, because the patient could give me no clear history, but by tracing his movements I found that for one hour each day he went into a factory where china cement was being manufactured. In the manufacture of this cement wood alcohol was used. After the discovery of this fact I insisted that he stop going into this factory, and with the use of galvanism for some months he recovered practically normal vision.

DR. ROBERT SATTLER, Cincinnati: My experience with these cases has not been so favorable. In two cases of wood alcohol blindness it was complete and permanent and not influenced favorably by treatment. No other damage to the general nervous system or special senses resulted, except complete white atrophy of the optic nerves.

DR. HENRY H. TYSON, New York: It is a well-known fact that some individuals are more susceptible than others, and that in the majority of cases the vision fails about one-half after the initial recovery. My paper referred especially to those cases of amblyopia due to *inhalation* of methyl alcohol. I think many cases of methyl alcohol poisoning in various degrees occur in the trades and are not recognized by the general practitioner, and that it is a subject which deserves serious consideration.

HEREDITARY OPTIC ATROPHY WITH *X*-RAY FINDINGS.

WILLIAM EVANS BRUNER, M.D.,
Cleveland, Ohio.

Concerning the etiology and pathology of hereditary optic atrophy of the Leber and other allied types, little or nothing definite is known. This paper pretends to give no new theory, but does show some points of interest, and especially one—the *x*-ray findings, which suggest the advisability of further study along this line in other cases of the same or allied diseases.

Mr. A. J. S., aged thirty-six, consulted me November 22, 1911, with a history that he had worn glasses nine years but had had no special difficulty with his eyes until last July, when he noticed a blur before them so that he could see only half or part of an object. He went to an optician who changed his glasses, without benefit. Since then he has consulted several oculists in Cleveland and was for a time under the care of a physician in Chicago without any improvement, in fact, with steady deterioration of vision. Last winter he had some headache, frontal and occipital, but no digestive disturbance, and has never had nausea, vomiting, or dizziness. Two and a half weeks ago he had severe headache for three days and since then he thinks his vision is worse. His general health has always been excellent. He had gonorrhea when a young man, but denies syphilis. Has smoked moderately, about three cigars daily, and has not used any at all for two or three months. Takes only an occasional glass of beer. Has been married nine years. His wife has had two miscarriages; they have no children. He was wearing the following glasses given him in September:

O.D. sph. $-2.75 \bigcirc$ cyl. -0.25 axis 90°
O.S. sph. $-2.75 \bigcirc$ cyl. -0.50 axis 180°

He was engaged in office work until his sight began to fail him.

Family History.—One maternal uncle, now seventy-six years old, has been blind for years. He was told that his trouble was with the optic nerves and treatment would accomplish nothing. He drank considerably. Another maternal uncle is said to have gone blind overnight and committed suicide. This patient's father and mother, the latter still living, eighty-one years old, have had no trouble with the eyes. They were not related. The patient has one brother and six sisters. All the sisters except one are married. The brother has trouble with his eyes as has one sister and also a son of one of the sisters, his nephew.

His brother writes me that when he was twenty-nine years old his vision failed him. It came on within a few days, everything looked hazy, but he "could see an object from the outer circle of the eye," to use his own expression. Evidently he had a central scotoma. He was treated by Dr. Thompson, now deceased, of Indianapolis, who applied leeches, gave him mercury and potassium iodid, the latter up to more than 500 grains in twenty-four hours, and strychnin. He says the doctor pronounced it optic neuritis and thought it hereditary. It is known the patient drank to excess. He improved somewhat under treatment and is able to work. I am still hoping to have the opportunity of examining him.

The sister, Mrs. T., of Toledo, aged forty-one, came to see me February 27, 1912. She had good eyes until seven years ago, aged thirty-four, when her sight gradually failed her. She first noticed blurring in reading. She has never had any pain or inflammation in the eyes at any time. She finally lost central vision, so that when she wanted to see a person's face she would look at his waist or above his head. She did not notice any change in the condition of the eyes for three or four years, but since then thinks there has been slight improvement. She has been married twenty years, has two children, a son eighteen years old and a daughter fifteen, both of whose eyes are good. Her general health is excellent. From another source I learned that she was for a while addicted to the use of morphin, and when this was overcome, to alcohol for a time. Examination shows vision

of O.D. $\frac{1}{60}$, O.S. $\frac{2}{60}$. She is unable to read 2 M. type. Ophthalmoscopic examination shows in O.D. media clear, disc round and slight physiologic cup, whole disc decidedly pale, but especially the temporal half, slight scleral ring, arteries narrow, fundus somewhat granular, otherwise nothing pathologic. O. S. shows similar appearance of optic atrophy with gray nerve more marked in the temporal half and contracted arteries. The fields show small central absolute scotoma in each eye, with practically normal peripheral limits (see Chart I).

The nephew, now a doctor of Chicago, writes me that his eye trouble started in May, 1903, shortly after his marriage,

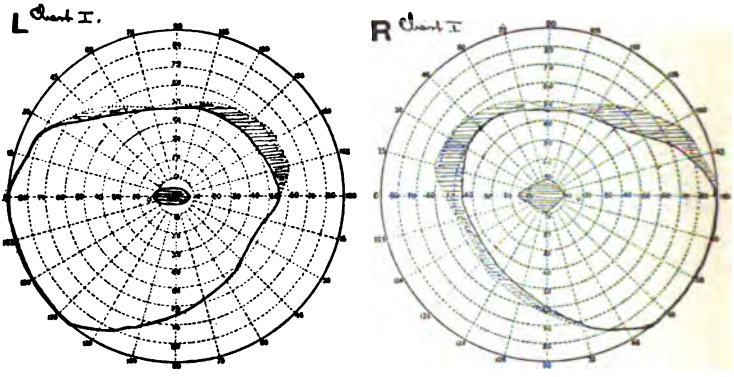

Chart I.

when he was twenty-two years of age. He first noticed dim vision which gradually increased so that by fall of the same year he was "entirely blind." He says he had a central scotoma. There was no specific history and none of the oculists whom he consulted could find any cause for the progressive optic atrophy, so diagnosed by them all, except possibly heredity. He took mercury and potassium iodid, also thyroid extract, pituitary extract, strychnin, etc. After more than a year he thinks he began to improve under homeopathic treatment, and he now has had one-fifth normal vision for several years. Vision is now as from the start worse in his right eye.

Examination of our patient shows pupils equal and re-

sponsive to light and all movements of the eyes normal. Vision equals fingers eccentrically in each eye.

Ophthalmoscopic examination shows the discs slightly edematous on the nasal side, with all edges hazy, especially the inner, pale in the temporal half, veins rather full, in other words a mild or low grade optic neuritis starting evidently as a retrobulbar neuritis with beginning atrophy. The fields show a central absolute scotoma in each eye with slight concentric contraction of the form fields and complete inability to recognize red and green (see Chart II). His knee-jerks are normal or possibly slightly diminished, station is good, no tremor, teeth are good.

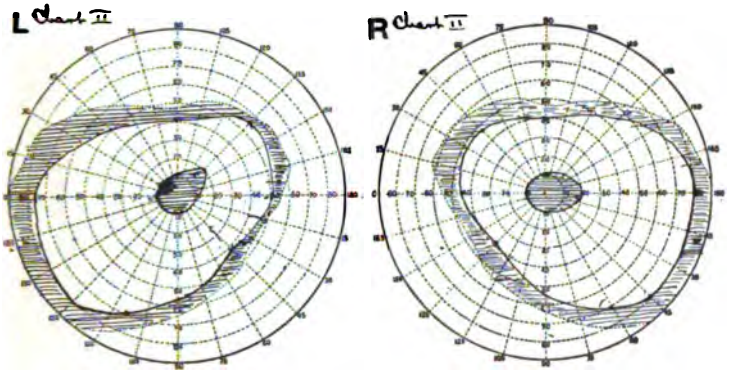

Chart II.

His family physician could find nothing abnormal in his general condition, the urinary analysis was normal, the Wassermann reaction was absolutely negative. In order that he might have a more thorough examination of his general condition he was referred to Dr. Hoover, who put him in Lakeside Hospital for several days for observation. He made a lumbar puncture and the examination of the fluid was negative in all respects. It showed no increased pressure and gave no evidence of lues. Other than a rapid pulse without any cardiac enlargement, suggesting probable lack of cardiac inhibition, he could find nothing abnormal in his condition. He inclines to the opinion, however, that the man probably has a brain tumor, though he acknowledges

that there are no focal or localizing symptoms whatever and bases his opinion upon the appearance of the optic nerves.

The patient did not complain of catarrh, but there was slight hypertrophy of the turbinates, so I sent him to Dr. Ingersoll to determine the possibility of any trouble with the sinuses, especially the ethmoidal or sphenoidal. The examination was negative, but the doctor suggested an *x*-ray examination, which was accordingly made. While this revealed nothing anteroposteriorly, the lateral view showed much enlargement of the sphenoidal cells and the walls very thin, but no evidences of any retention. On the strength of this the doctor tapped the sinuses, found noth-

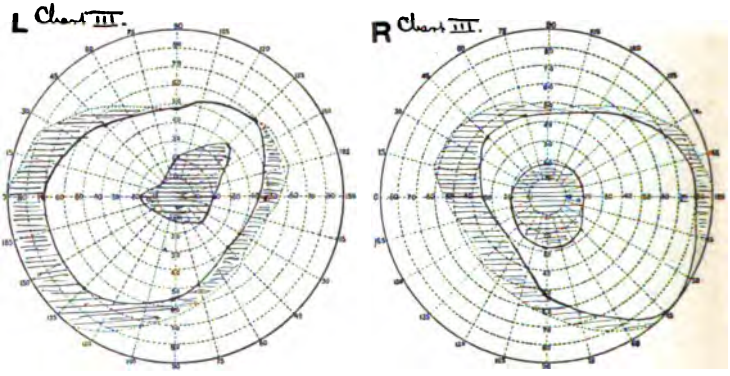

Chart III.

ing in one side and only a little clear serum on the other. He syringed this out a few times without any effect whatever upon the eye condition.

Under all the circumstances I looked upon this as a case of probable hereditary or familial optic neuritis and atrophy of the Leber type. He was put upon mercury and later potassium iodid in increasing dose without any effect. In January his vision was worse and fields showed enlargement of the blind spot in each eye (see Chart III). The edema of the nerves, which always was very slight, seemed less and the pallor more marked. January 10th, a gland under the left angle of the jaw was enlarged and slightly tender.

At the end of another week this was smaller, but one directly beneath the middle of the jaw was enlarged. This swelling also soon disappeared. For a few days about this time he complained of having some occipital and temporal headache. Dr. Ingersoll, who was seeing him from time to time, reported more fully at this time as follows: "I saw him first on November 23, 1911, and found that his bone conduction was shortened in each ear. This speaks for lues or brain tumor. The hearing was normal. Nystagmus (from turning) to the right fifty-five seconds and to the left sixty-two seconds, no spontaneous nystagmus. The normal nystagmus (from turning) is usually about thirty seconds, so that his nystagmus was nearly double. This condition would speak for increased brain pressure and lack of inhibition. This morning his nystagmus was seventy-one seconds to the left and ninety-five to the right. This shows considerable increase in nystagmus and decrease in inhibition, and of course would speak for increased pressure." I decided at this time to send him east to see Dr. de Schweinitz and Dr. Spiller. Dr. de Schweinitz reported as follows: "I find as you have done exceedingly defective vision dependent upon low grade neuritis doubtless beginning as a retrobulbar neuritis associated with extensive degeneration of the papillo-macular bundles. From the patient's history it would seem that the diagnosis should be familial optic nerve atrophy of the Leber type. I do not recall that I have before *x*-rayed a patient with this type of optic nerve atrophy, but certainly the stereoscopic *x*-ray plate shows marked thickening, either in the sphenoid region or in the neighborhood of the sella, and it occurs to me that this lesion, whatever it may be, has something to do with the optic nerve disease. While none of the general symptoms of pituitary body changes are present, or at least only a few of them, I would think it quite worth while to investigate very thoroughly from that standpoint tolerance to sugars, etc. It could do no harm to try very thoroughly in addition to the sweats and mercurials either thyroid or pituitary body medication."

Dr. Spiller reported: "The family history of your patient is typically that of the family type of optic atrophy and cannot be ignored. The *x*-ray shows a projection upward of

the floor of the sella turcica and suggest that the pituitary body may have its function impaired in this way. It seems possible that a family abnormality of the skull may exist and may be the cause of the optic atrophy. I do not know in how many cases of the family optic atrophy *x*-ray plates have been made. The only symptoms that could be attributed to tumor are those of the optic nerves and I do not think they are sufficient for a positive diagnosis of tumor, though it cannot be positively excluded."

Upon the patient's return extract of pituitary body was tried and later thyroid extract. Electricity was also given a trial, but he continued to grow worse. Another *x*-ray, this time stereoscopic, was taken March 15th, while a probe was in place in the sphenoid cells (see Fig. 1). These plates do not show any change since the first *x*-ray taken two months before. On the possibility that these enlarged sphenoidal cells may be having some bearing upon the optic nerve condition we decided that it would be wise for Dr. Ingersoll to open the cells more freely so as to establish better drainage, and this accordingly was done. About this time the patient complained occasionally of slight dull frontal headache and a little dizziness for a few days.

At this time we set about trying to get *x*-ray plates of other members of the family who have the disease for comparison with our patient's radiographs. The brother, unfortunately, I have not yet been able to see. The sister came on from Toledo, and as indicated above an examination of her eyes shows optic atrophy with central scotoma in each, apparently a typical familial optic atrophy. An *x*-ray examination of her shows much enlarged sphenoidal cells though not so much as in our patient under discussion.

The nephew in Chicago had an *x*-ray made and sent to me. It also shows much enlarged sphenoidal cells. I thought it would be interesting to compare these plates with those of some members of the family who did not have the disease, so had plates made of his mother and of one sister. They both show much smaller sphenoidal cells than in the affected members of the family. For further comparison I had some plates made of other normal individuals and they all show much smaller cells, with a possible exception of one. While these plates are not sufficient upon which to base any

Fig. 1.—*X*-ray plate of a case of hereditary optic atrophy.

conclusions as to the variation in the size of normal sphenoidal cells, and while I cannot from this one case of this family conclude that the condition at the base of the brain has anything to do with causing the optic atrophy, these findings at least suggest the advisability of studying other patients thus afflicted in regard to this point.

Berger makes a statement that "A number of cases of hereditary optic nerve atrophy are due to an irregularity in the growth of the sphenoid bone." I was unable to see this article, but Posey* says, "He does not seem to give sufficient proof to support this hypothesis." "The sphenoidal bone," quoting him further, "is the keystone of the skull, and the numerous changes which the orbit as well as the other cavities of the skull undergo during life are chiefly occasioned by the growth of this bone. It has also been shown by Virchow that the development of the sphenoid bone is often not attained until very late in life, which would account for the failure of the disease to appear at times until late in life." It is true also of the sphenoidal cells that they do not develop or attain their full size until puberty or later. "Unfortunately it is impossible," quoting further, "by measurements of the skull to judge accurately of the form and size of the bones composing its base, so that little can be gained by a study of the external configuration of the skull in these cases." Just here, however, the *x*-ray may now give us some definite information and be of value.

Recent researches in certain toxic amblyopias point to the primary lesion in many cases of retrobulbar neuritis being in the retina. The same may be true in Leber's disease. "To sum up," quoting Cargill,† "we must suppose that innately unstable macular ganglion cells suffer some nutritional disturbance, and that consequently degenerative and atrophic changes ascend by their axons or axis-cylinder processes to

* Annals of Ophthalmology, vol. vii, 1898, No. 3.
† The Ophthalmoscope, vol. x, 1912, page 67.

the optic nerve and produce breaking down of the myelin sheaths behind the lamina cribrosa and probably secondary interstitial changes, evidenced first by hyperemia or slight inflammation of the papilla, and later by pallor."

Despite all treatment the patient's vision has steadily grown worse. The blind areas have grown much larger, including now all the nasal portion of the right field in addition to the large central scotoma and in the left eye the enlarged scotoma with almost as much of the nasal field (see Chart IV). Nothing has been attained by treatment from the eye standpoint or general medication, and nasal

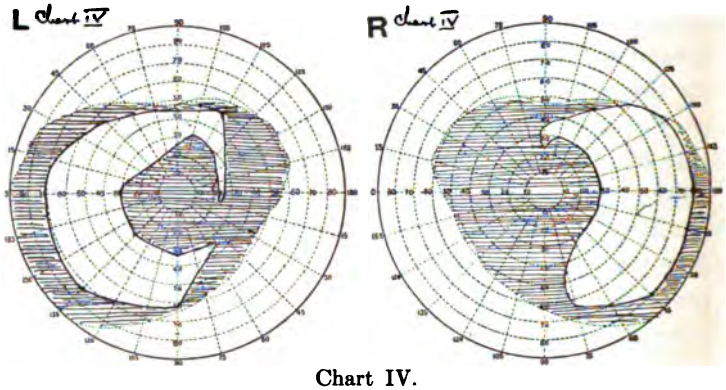

Chart IV.

treatment has accomplished nothing. He was anxious to see a surgeon with reference to an exploratory operation at the base of the skull, so I sent him to see Dr. Harvey Cushing, of Baltimore, who reports in part as follows:

"I think without question the Leber diagnosis is the correct one. It is, of course, remarkable that there should be a tendency toward undue enlargement of the sphenoidal cells. During the four or five days he has been here his vision has gone down with great rapidity and he is now almost completely blind in the right eye. In going over his story intimately it seemed to me that without question early

in the history of the trouble and before his vision began to fail he had some pretty definite indications of an increase of intracranial pressure, and I am sure that had we seen him at that time we should unhesitatingly have done a subtemporal decompression. After discussing the matter freely with the patient a decompression was performed," and the doctor reports that he "found that he had an exceedingly edematous brain, with great excess in the amount of fluid free in the subdural space and under considerable tension. I have not the remotest idea what this means and what the decompression and liberation of the fluid will accomplish. If this excess of fluid edema is actually the underlying factor, I should have expected him to have more discomfort and some indications of labyrinthine troubles akin to those which he had in the optic nerves."

Six days later the doctor again writes, "I doubt very much whether we have accomplished anything, for I fear his vision is going down in spite of the decompression and the relief of tension from the serous accumulation which I suppose is something in the nature of Quincke meningitis. This doubtless accounts for the labyrinthine troubles and possibly for the low grade of choked disc, though I doubt whether it was the underlying factor. * * * To call attention to the peculiar sphenoidal enlargement which the members of his family show will be a most important contribution."

Three weeks after the operation he writes once more enclosing some field charts taken just before and since the operation. "Whether the slight improvement," he writes, "had any relation to his operation I cannot tell. Of course, the vision in these states fluctuates considerably and there has been just a slight temporary improvement. I am glad at all events that we have given him a chance of benefit from a decompression without having an increase of tension, which is inevitable under anesthesia, serve to completely and permanently blind him as it threatened to do for a day

or two after the anesthesia. This is another incident which makes me feel that variable tension conditions have after all something to do with his particular form of visual disturbance. The constriction of the fields, though it leaves a binasal hemianopsia, is not like a binasal hemianopsia which we so commonly see as a terminal stage of the secondary atrophy from a choked disc."

On May 28th, or four weeks after the operation, the patient again called at the office. He had had a subtemporal decompression upon the right side and has now recovered

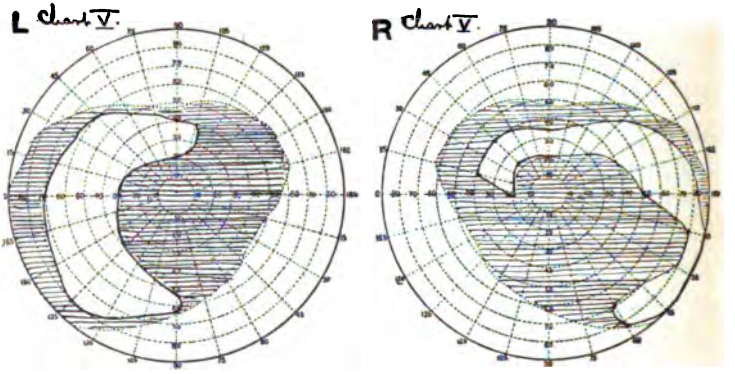

Chart V.

from the effect of the operation. He states that his eyes kept growing rapidly worse after he reached Baltimore, and on the morning of the operation he could not see anything with the right eye. For two days afterward, as indicated in Dr. Cushing's letter, he was totally blind in both eyes. Then his vision improved for several days, since which time it seems to have kept about stationary. Vision: O. D., hand movements on the temporal side.

O. S. counts fingers. Pupils are equal and respond readily to light. He has had no headache and no dizziness since the operation. Ophthalmoscopic examination: The discs

are decidedly pale with edges only slightly hazy, the veins good sized, arteries slightly contracted—a well-marked secondary optic atrophy. There is slight horizontal nystagmus of both eyes. Examination with the perimeter shows the fields smaller than before the operation (see Chart V), but larger than when they were examined at Baltimore before or shortly after the operation. The eyes tire very quickly, so that after looking for a time he will not be able to see the white disc at the point where he saw it positively a few minutes previously. The outlook as regards the patient's vision is certainly not encouraging. It is too early as yet to say whether the operation will have any effect in preserving what sight he now has.

In addition to the typical cases of Leber's disease there are, as described by Cargill,* "certain atypical borderland varieties which resemble Leber's disease in being examples of a special family vulnerability of the optic nerves, but differ in that the damage extends beyond the macular neurons to the whole nerve, resulting in general atrophy."

1. Cases of family or hereditary congenital or infantile optic atrophy setting in either before birth or very early in life.

2. Cases of peripherally contracted fields associated with the central scotoma and ensuing general optic nerve atrophy with permanent great loss of vision.

3. Cases in moderate smokers of the same family, both eyes being affected either simultaneously or one before the other and no improvement following the discontinuance of tobacco.

4. Some rare cases of serious and even permanent impairment of vision from optic nerve atrophy coming on in young men after matrimony or after long-continued sexual abuse.

In conclusion, therefore, whether this patient is a typical case of Leber's disease or, what seems more probable from

* The Ophthalmoscope, vol. x, 1912, page 68.

the subsequent history, one of the allied varieties, is possibly a question. The interesting problem is what relation, if any, the enlarged sphenoidal cells and the condition at the base of the skull bear to the optic atrophy in this family; whether, in other words, the enlarged sphenoidal cells constitute the hereditary characteristic and the optic atrophy is merely secondary. In regard to this I would not feel warranted in venturing an opinion on the study of only one family, and so hope that other patients presenting similar symptoms may be subjected to like *x*-ray examinations.

DISCUSSION.

DR. ARTHUR J. BEDELL, Albany: I wish to present the stereoscopic *x*-ray plates of four cases of the condition referred to by Dr. Bruner. The first three are brothers, aged nineteen, twenty-six, and twenty-eight, and in all is found a very prominent clinoid process with deep sella turcica. The fourth, a cousin of the others, aged eighteen, does not show the same process. As these pictures are very different from Dr. Bruner's, I do not wish to draw comparisons, but will report the cases in detail at some later time.

DR. B. ALEXANDER RANDALL, Philadelphia: In reference to the point made of the exaggerated response to the rotation-test of the labyrinth, I would call attention to the influence, perhaps very great, in these cases of the central scotoma; and would raise the question, for which I have not an answer at present, whether all cases of central scotoma in their inability to fix will not show a materially exaggerated response in nystagmus to the rotation-tests?

A CASE OF TRANSIENT BLINDNESS, COMPLETE IN ONE EYE, PARTIAL IN THE OTHER, WITH DOUBLE OPTIC NEURITIS.

HOWARD F. HANSELL, M.D.,
Philadelphia.

The patient, a girl of eight years, consulted me December 7, 1911. She had in the right eye total loss of vision, including the perception of light, and with the left eye counted fingers at three feet. The mother stated that her daughter had two years ago complained of not seeing well, but the complaint had not received her serious attention until lately, when the vision had become so greatly diminished that the child stumbled into objects that were not in the direct line of vision, and was compelled to give up school work. Recently an internal squint of the right eye had developed. She had frequent and severe headaches, attended with vomiting and loss of appetite. The family history is good, and there is no suspicion of tuberculosis or syphilis. The single factor in her personal history that might be important in throwing light upon the cause of the blindness was that two weeks before consulting me the patient, while away from home, fell from a bed and struck her head upon the floor. She seemed to suffer only temporary inconvenience and no importance was attached to the incident.

Examination.—The movements of both balls are limited in all directions. The right eye is deviated downward and cannot be elevated beyond the median line. The left is turned down in the act of vision, and the field is limited downward and outward as tested by a small electric lamp. The pupils are dilated, equal in size, and react normally.

The ophthalmoscope showed double optic neuritis and edema of the adjacent retinas, of higher grade on the right

side than on the left side, and great tortuosity and distention of the veins. No patches of exudation or hemorrhage or aggregation of pigment. Both knee-jerks were absent.

The patient was a well-nourished child, sturdy and strong, and of average size, and seemed to be in perfect health. The Wassermann and tubercular reactions were negative, and several *x*-ray plates, made by two experts, excluded osseous formations and new-growths of large size or density. The specific gravity of the urine was 1024; no albumen; no sugar. The examination of the nose and adjacent cavities revealed nothing abnormal.

Treatment.—Decompression of the skull was considered, only to be rejected. Lumbar puncture was made and several ounces of clear cerebrospinal fluid withdrawn. Vision commenced to improve almost immediately. Treatment was continued by means of inunctions of mercury, ½ dr. twice daily, and small doses of potassium iodid. In three weeks vision of R.E. = $\frac{20}{200}$, L.E. = $\frac{20}{100}$; the edema of the nerves and retinas had entirely disappeared and the normal ocular rotations restored, although the right seemed on a lower plane than the left. March 22, V.R.E., $\frac{20}{40}$; L.E., $\frac{20}{30}$; orthophoria. The retinal veins are still tortuous, but there is no edema. The temporal sides of the discs are a trifle pallid.

This case presents two points of especial interest: First,

The Diagnosis.—It may be admitted without argument that there was an increase in the intracranial contents which, by direct contact or by pressure indirectly, mechanically induced dropsy of both nerve-sheaths, and of the optic nerves themselves, of greater intensity on the right side. The character and site of the lesion are unknown. The absorption of the edema of the nerve and the retina, and the recovery of vision, as well as the restoration of power of the weakened extra-ocular muscles, may properly be attributed to the lumbar puncture, by which the intracranial pressure

was reduced, and to the mercury, and can hardly be classified under spontaneous cures.

Spontaneous cures have been reported: Wilbrand* saw double choked discs entirely recover in the case of a man with thrombotic softening; and Oppenheim the same in the case of a four-year-old girl who died of brain tumor.

A hemorrhage at the base of the brain as a result of striking the head against the floor might explain the symptoms, and its absorption, the recovery; but the two years' increasing loss of vision points to an entirely different etiology. Gumma or tubercle of the meninges is excluded by the history; meningitis, by absence of pain or delirium; tumor, either benign or malignant, by the recovery; abscess, encephalitis, embolus, or thrombus, by the clinical history. Moreover, this patient presents optic neuritis and not choked disc, and while the distinction may be rather arbitrary than real, the diagnosis between them may be determined both by the degree of the swelling, as compared with the refraction of a normal part of the eye-ground, and by the accompanying symptoms. The degree of the swelling was moderate—not more than 3 D. The blindness of the right eye was temporarily absolute, rarely found in choked disc, and frequently in acute optic neuritis, especially the retrobulbar form. For these and other reasons tumor of the brain, abscess, and the various forms of meningitis may be excluded, but that pressure was exerted upon the optic nerves and upon the extra-ocular muscles which lie in juxtaposition to the chiasm admits of no reasonable doubt. Every nerve entering the right orbit, and most of those entering the left, were disabled and probably by pressure of intracranial fluid. The most plausible assumption, arrived at by reasoning and exclusion, is that in this patient there was an increase in the amount of cerebrospinal fluid, compressing to a limited extent the optic nerves and ad-

* Wilbrand and Saenger, p. 570.

jacent motor nerves. That the total blindness in the right eye was not due to compression of the nerve in its sheath only is shown by the low degree of swelling of the nerve-head—an optic neuritis with retinal edema rather than a choked disc, the absence of hemorrhages, and the nearly normal caliber of the arteries. The diagnosis, therefore, should assume the presence of serous infiltration between the fiber bundles in the optic nerve and sufficiently great to bring about temporary but total abolition of function. The usual forms of optic neuritis, both toxic and constitutional, classified by Wilbrand and Saenger under the titles of toxic, infectious, hereditary, retrobulbar, multiple sclerosis, and myelitis, may be excluded because of the absence of significant history, of general symptoms, and of central scotoma.

The injury to the head in falling may have been a factor in the causation, but if the history of failure of vision preceding the accident is to be credited, it could only have exaggerated the symptoms.

Huisman* reported the case of a boy who had given his head a sharp rap against a wall. The patient had left-sided adducens paralysis, and optic neuritis at first on the left and later on the right side. The left eye was temporarily blind. Eventually both papillæ became normal.

Second, *The Treatment.*—Decompression of the brain was, after consultation, substituted for by lumbar puncture. My experience with the results of the former operation, is that it is dangerous to life (I have seen two cases recently terminate fatally within twenty-four hours of its performance), is seldom followed even temporarily by improvement of vision, and should be reserved for cases of choked disc, after failure of medicinal means.

Frazier† quotes Piollet, who collected a series of fifty cases

* Deutsch. med. Wochens., 1899, p. 554.

† Tumors of the Cerebellum.

of brain tumor in which lumbar puncture was employed on eight cases. In four there was temporary amelioration and four died within a few days. Death was attributed either to the sudden disturbance of intracranial pressure or the dislocation of the pons and medulla into the foramen magnum. Lumbar puncture is in cases of brain tumor of little or no service. The opinion of Stadelman* and Furbringer† as to its efficacy is decidedly unfavorable. Most authors speak well of it as a means of treatment in chronic hydrocephalus, and acute hydrocephalus has been promptly and permanently cured by it.

DISCUSSION.

DR. CHARLES H. MAY, New York: I would like to relate the history of a patient which resembles that of Dr. Hansell's case, except in pressure symptoms: A young woman, twenty-eight years old, complained of slight dimness of vision. Examination of the fundus showed no changes, but a week later both discs presented slight blurring of the margins. After three weeks there was almost total blindness. Then the discs presented rather more blurring of the margins, and the picture was one which we usually designate as commencing optic neuritis. At the end of the fourth week the blindness had become complete. As the etiology was obscure, a great many consultants in various departments of medicine were called in; among the eye consultants there were Drs. Gruening, Weeks, and Born. The family physician examined the patient very carefully, the tuberculin reaction was absent, the Wassermann test was negative, examination of the blood gave no information. An expert neurologist could find nothing abnormal. Under these circumstances it was decided to perform lumbar puncture. This was after the blindness, incomplete at first, but complete at the end of three weeks, had lasted for several days. When everything was ready for lumbar puncture, the patient objected to this procedure, and claimed that she was conscious of a faint perception of light. I could discover no evidence of

* Mitth. aus der Gebiet der Med. und Chirurg., ii, 1897.
† Berl. klin. Wochens., 1895, p. 272.

this, but in deference to her wishes the operation was postponed. Under these circumstances, in ignorance of the cause of blindness, the patient was placed upon iodid of potassium in increasing amounts, together with small doses of mercury. After a week there was a return of a little vision; after four weeks the vision had returned to $\frac{20}{40}$. Six weeks later vision was $\frac{20}{20}$, the fields were fairly normal, with contraction of perhaps 10 or 15 degrees, and the optic nerves were beginning to become pale. At the end of three months the discs had become bluish-white, with sharply defined margins. This picture is still present, two years after the temporary blindness, namely, bluish-white discs with sharply defined margins. There persists a contraction of 10 or 15 degrees in the periphery of the fields, and vision is $\frac{20}{20}$ –. The cause of the affection has not been discovered. Had lumbar puncture been performed, as arranged, the recovery of vision would have been attributed to the effects of that procedure. As it is, all who have been in consultation in the case are forced to admit that they do not know the cause of the neuritis, with subsequent atrophy, nor that of the temporary blindness.

DR. R. A. REEVE, Toronto: Exceptionally one will meet with an anomalous case. Just before leaving home a boy was brought to me who had lost the sight of the left eye. He had had absolutely no sign of any disease. He had never had a headache in his life and none of the symptoms of pressure whatever, and was a healthy boy. All sorts of tests had been made by experts except the tuberculin test, and there was no reason to suspect tubercle, although I advised the usual skin test. I found in his left eye the secondary so-called atrophy of the optic nerve. The nerve was quite pallid, the edges slightly disturbed, and the vessels sinuous. The right eye presented the picture of simple optic neuritis and not choked disc. The pupillary reactions and vision of right eye were normal, the field of vision and the color fields were unimpaired. I was just leaving home and I had no opportunity of examining the case further, but I thought I would mention it as one of the anomalous cases different from that presented by Dr. May, but one which seems rather puzzling as to its etiology and as to the indications for treatment.

DR. HIRAM WOODS, Baltimore: It is often hard to judge of the apparent effect of remedies. I had, last winter, a case the result of which I learned only last week. A boy of six years was sent to me from a town in West Virginia. He was totally blind in both eyes. He had started out to go on a picnic with his family, and on the way to the station had a vomiting attack, was taken home, and found blind. It looked like a sudden attack of toxic blindness, but I could not find a history of anything of that kind. The boy had an optic neuritis in both eyes; the swelling was certainly 3 or 4 D. I saw him probably ten days after the blindness came. Dr. Cushing also examined him, and suggested a lumbar puncture, which was done. The spinal fluid was examined by a Wassermann test and was negative. He was given the von Pirquet test, and it was positive. It usually is in children, and it is my impression the tuberculosis experts do not rely much now on a positive von Pirquet in children. Cushing wanted to do a decompression, but the parents refused. The boy left Baltimore without perception of light. He was there ten days. The family physician put him on purgatives and small doses of bichlorid of mercury, and says he is entirely well. The cause of the optic neuritis we never were able to discover. He had no headache when I saw him, nothing but blindness and unexplained neuritis. According to his physician, who is able to make the test, vision has been restored to normal for these six or eight months.

DR. SAMUEL D. RISLEY, Philadelphia: I have been very much interested in Dr. Hansell's case because it represents in many of its aspects cases occurring in my own experience, where I found it difficult to explain the more or less sudden onset of blindness. A woman applied for treatment at the Wills Hospital, who related that, while over the ironing board in her kitchen on a hot summer day she suddenly lost her vision, the blindness being so near complete that she could not move about without assistance. I found edema of the retina in both eyes, with full veins and a bright red spot at both maculæ. She slowly recovered under the administration of iodid of potassium, but with impaired vision in consequence of macular changes which proved to be permanent. I have been at a loss for a satisfactory explana-

tion for this sudden occurrence of serious disease. During the last few years I have been much interested in the findings in a considerable group of cases which are more or less similar, but only one other where the blindness was so nearly complete and the onset sudden. Not so rare are the cases with full veins, more or less marked edema of fundus, impaired sight with central or paracentral scotomata, and contraction of the fields of vision. The conditions have been associated with a urine of high specific gravity, sometimes with a trace of albumen but without sugar, and high blood-pressure. Last September I was much interested in a paper read by Dr. Fischer, of Cincinnati, in which he claimed that all of the edemas are due to an acidosis of the tissue fluids and the blood stream; and that the proper treatment was the use of alkalis. It led me to think that if this contention were true, it was possible that the beneficial result that we have obtained from the administration of potassium iodid in many forms of disease was not due to the iodin in the potassium iodid, but because it was one of the alkaline salts. With this idea in view I have in a large group of cases presenting these symptoms in more or less characteristic form been administering the alkaline earths, commencing with sulphate of magnesium as a purge once a week or more frequently, and using considerable doses of chlorid of calcium, a very soluble alkaline earth salt, and the results have been most gratifying and more rapid than I had ever received from the use of iodid of potassium. It is conceivable that in Dr. Hansell's case we may have an illustration of this condition of the tissue. He tells me that the specific gravity of the urine was 1024 in his patient; the blood-pressure was not taken. It is conceivable that there was not only edema of the retina, but, as he demonstrated by lumbar puncture, an edema of the intracranial structures as well. The question is whether these cases may not be what Dr. Fischer claimed: an acid condition of the blood stream and tissues, and that the logical treatment would be the administration of the alkaline earths.

DR. HOWARD F. HANSELL, Philadelphia: Of course no principle or no deduction can be drawn from the effects of a remedy in a single case. I was impressed in this one with the recovery of vision within a few hours after the

lumbar puncture had been made. Its effectiveness also was shown by the return of function to the extra-ocular muscles of both eyes. The recovery has been complete, and there are to-day no atrophy, no blueness of the nerves, and no trace of discoloration.

FLAT SARCOMA OF THE CHOROID.

CASSIUS D. WESCOTT, M.D.,

Chicago.

I wish to add to the record two cases of flat sarcoma of the choroid. In 1904 Mr. Herbert Parsons* reported a case of ring sarcoma of the ciliary body and iris, and reviewed the literature of diffuse sarcoma of the uveal tract. He recorded 35 cases, including his own, but regarded two cases reported by Schiess in 1864 and 1865, and two reported by Hirschberg in 1869 and 1870, as probably inflammatory and not to be counted. In November of last year Drs. A. N. Alling and Arnold Knapp reported a case of ring sarcoma of the ciliary body, and reviewed the literature of that variety of the diffuse sarcomata. They refer to nine cases, including their own, four of which are described by Parsons, "in which a diffuse growth was present in the form of a complete ring, involving the ciliary body and apparently originating therein." In addition to the 40 cases referred to in these two papers, I find that Arnold Knapp reported a flat sarcoma of the choroid,† and Paul G. Woolley, a flat tumor of the ciliary body and choroid‡ in 1905; Mr. E. E. Hender-

* Archives of Ophthalmology, vol. xxxiii.
† Ibid., vol. xxxiv.
‡ Johns Hopkins Hospital Bulletin, 1905.

son, a flat sarcoma of the choroid* in 1908; Harold Goldberg, a diffuse tumor of the entire uveal tract,† and H. Luedde, a diffuse tumor of the choroid‡ in 1909, making 45 cases in all.

To Fuchs has been given the credit of first distinguishing between diffuse and circumscribed sarcomata of the uveal tract§ and he reported three cases in 1882. De Wecker, however, in 1876, in the Graefe-Saemisch Handbuch, stated that in two cases such a diffuse tumor had been seen. In 1894 Mitvalsky reported two cases, and first used the very descriptive term, "Flächensarcom." Ewetzky in 1898 first used the term "ring sarcoma" to describe those tumors confined to the ciliary body and encircling the eye. A study of the recorded cases and my own shows that the sexes have been about equally affected. The youngest patient was twelve and the oldest seventy-two years old. In many of the cases the disease was evidently of long duration—from seven months to ten years. There is a history of injury or operation in quite a percentage, the trauma dating from nine weeks to seven years before the discovery of the tumor. In most of the cases glaucoma was present, but was not constant in all. Parsons calls attention to the fact that a number of the eyes were enucleated because of absolute glaucoma, and the tumor was discovered in the laboratory. Goldberg suggests that many eyes excised for glaucoma may contain flat sarcomata which are not discovered. In his case there was no suggestion of tumor before operation, and no macroscopic evidence of it on section of the globe. Extra-ocular extension occurs frequently, sometimes early, is often multiple, and follows the perivascular lymph-channels through the sclera. All observers have been impressed by the tendency of these tumors to infiltrate the tissues, as opposed

* Trans. Ophthalmological Society, U. K., 1908.
† Annals of Ophthalmology, 1909.
‡ Graefe's Archiv, 1909.
§ Fuchs, Das Sarcom des Uvealtractus, Wien, 1882.

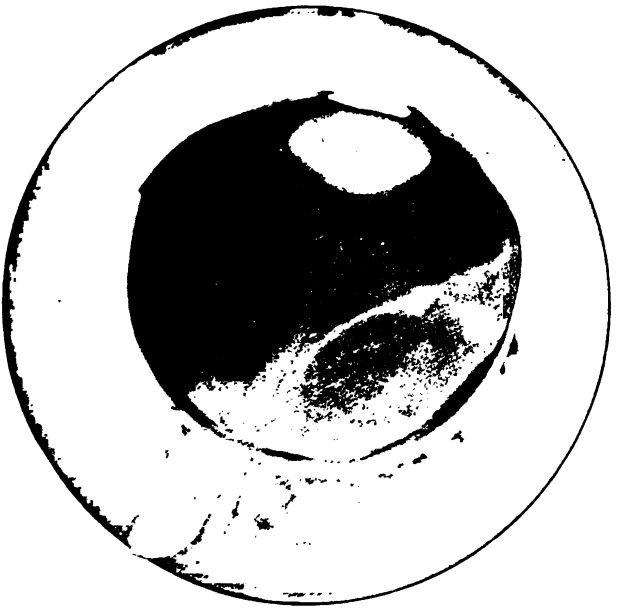

Fig. 1.

Fig. 2.—Flat sarcoma of the choroid.

to the formation of a definite tumor. Parsons is of the opinion that they are endothelial in origin. He bases his opinion upon the character of the cells, the frequency of an alveolar arrangement, the tendency to myxomatous degeneration and necrosis, and the ease and rapidity with which they invade the lymph-spaces of the neighborhood.

CASE 1.—In September, 1894, I was consulted by a busy railway official, aged fifty-six years, for glasses. He had complained only of the receding near point, and had worn glasses for eight years which he had obtained of an optician. His vision with correction was: R.E. = $\frac{6}{12}$; L.E. = $\frac{6}{6}$. Through the small pupils the ophthalmoscopic examination was very unsatisfactory, and nothing was seen to account for the low vision in the right eye. The patient thought he had never seen quite as well with that eye, and had noticed no recent change. A mydriatic was proposed, but declined for want of time. In March, 1897, three years later, the patient returned for stronger reading correction, and it was discovered that vision in the right eye was reduced to counting fingers. A mydriatic was again urged, but was again declined. Through the small pupil a swollen nerve could be made out, and some nondescript changes in the choroid could be seen, but there was no apparent swelling of the choroid or detachment of the retina. At this time it was learned that the patient had always had good health but had been a hard drinker, and that he had been "held up" in March, 1894, six months before I first saw him, receiving a severe blow over the right eye and sustaining a fracture of the lower jaw on the left side. Under promise that he would return for a more thorough study of the eyes, he was referred to his family physician for general examination. He did not return until February, 1899, when he came complaining of redness and pain in the right eye. Upon examination the superficial vessels of the bulb were dilated, the tension was increased, and the pupil slightly larger than that of the left eye. The lens was very cloudy, the vitreous turbid, and the fundus could not be made out. The left eye was normal, and vision equaled $\frac{6}{6}$ with his old correction. The probability of a serious condition of affairs was

pointed out, and consultation proposed. I did not see him again until December 16, 1899. At this time the cataract was mature, the pupil fully dilated, the anterior chamber almost obliterated, the episcleral vessels large, and the tension + 2. The lens of the left eye was somewhat sclerosed and vision reduced to $\frac{6}{7}$.

Diagnosis of probable tumor was made, enucleation advised, and finally consented to. The operation was performed December 21, 1899. The nerve was cut 1 cm. from the globe, the scissors just escaping the extra-ocular portion of the tumor. Fearing that the nerve was infiltrated with tumor cells still further back, the cut end was seized with fixation forceps, drawn out, and another cm. was cut off. The wound healed kindly, a glass eye was worn with comfort, and the tumor did not recur in the orbit. The specimen was given to Dr. Brown Pusey for examination. The eye was placed in 10% formalin, gradually hardened in alcohol, frozen, and cut. One-half was mounted in jelly; the other half was imbedded in celloidin and sections were made for the microscope. The mounted specimen (Fig. 1) shows a thin, umbrella-shaped tumor of the choroid in the posterior part of the eye, extending forward irregularly, in some places beyond the equator of the globe, and passing out through one of the normal channels in the sclera to form a small tumor-mass measuring ½ cm. in each diameter alongside of the optic nerve. Sections stained with hematoxylin and eosin show a typical, moderately pigmented, alveolar sarcoma containing large and small round and spindle-shaped cells.

In September, 1900, the patient began to complain of much intercostal pain and some digestive disturbances and gave up his work. He grew rapidly worse until he was unable to retain or assimilate food of any kind; the liver was found to be greatly enlarged, and he died December 31, 1900. A postmortem examination was made by Dr. A. I. Bouffleur

a few hours after death, and the following is from the report of the examination:

Pathologic Examination.—A tumor the size of a hen's egg was found at the beginning of the third and fourth ribs, at the left of the vertebral column, just outside the pleura, apparently springing from the body of the third costal vertebra. In the lesser omentum several more or less pigmented tumor nodules of varying size were found. The liver weighed 4555 grams. The capsule was smooth and glistening, with no irregularities. The color was mottled brownish-red, with many yellowish-brown, greenish-gray, and dark-gray nodules, evenly distributed, slightly elevated, and varying in diameter from 1 to 30 millimeters. They were all approximately circular, the smaller ones being yellowish, while only those of 1 cm. or more in diameter showed the gray or greenish-gray color. To the touch the liver was firm and inelastic, the nodules being readily palpable and considerably more solid than the intervening substance. On section the liver cut with moderate ease and with but little variation in the resistance to the knife. The cut surface showed a great variation in the frequency of the nodules. In the left lobe they were quite few, lying in a mass of yellowish-brown liver substance. They were from 1 to 2 cm. in diameter, gray in color, the larger ones being darker in the center. They were harder than the liver substance and could be shelled out with but little difficulty, being apparently encapsulated. One large nodule near the gall-bladder was nearly 5 cm. in diameter, and of a mottled yellow and gray appearance. In the right lobe of the liver nothing could be seen but a mass of nodules of the same gray color and varying in diameter from 1 to 3 cm. No interlying liver substance could be seen in this portion. On the cut surface some of the nodules were quite black. The kidneys were normal—no tumor nodules. Stomach and intestines not examined. Brain and its membranes normal. No recurrence of the tumor in the stump of the optic nerve.

On microscopic examination the liver substance is seen to be highly congested and subject to considerable fatty infiltration. The tumor nodules are seen to be encapsulated and divided into many rounded alveoli by fibrous

trabeculæ. The tumor cells are large and polygonal, with round or oval nuclei, and in the small alveoli form concentric rows, suggestive of glandular structures. In some portions of the trabeculæ there are large collections of small, round, nucleated cells lying among the fibers. In some of the alveoli lying near the liver cells, and only where the capsule is thin and ill-defined, fat globules can be seen in the cells. Brown pigment is seen in the cells of some of the alveoli, but not in all the sections.

CASE 2.—In September, 1910, Mrs. K., aged forty-eight, was referred by Dr. C. J. Simons because of poor sight in the right eye and occasional attacks of pain and headache. Her general history was negative. Five years before she had noticed what she described as a shadow in the right eye. In November, 1909, she had consulted a colleague who reports that he found her vision in that eye $\frac{20}{200}$, the margins of the disc blurred and indistinct, and at the upper temporal side of the disc "a retinal opacity." The left eye was negative. He made a diagnosis of neuroretinitis. Treatment was without result and she passed from his hands in a few weeks. Dr. Simons reported that at times there was great edema of the lids and apparent protrusion of the eye, accompanied by much pain. These attacks began in July, 1910, two months before I saw her, and had grown steadily more severe. The patient stated that they usually lasted from one to three days, and had occurred as often as once a week. I found the external eyes normal, the irides bright, the pupil of the right eye moderately dilated and fixed. The tension was normal in both eyes. The ophthalmoscope showed complete detachment of the retina in the right eye, and transillumination elicited a very poor reflex, but no decided shadow from any quarter. There was no light perception. The left eye was negative, and with correction its vision was $\frac{6}{6}-$. Eleven days later the patient returned with an acute congestive glaucoma, and the eye was removed on the following day. The specimen (Fig. 2) was prepared by Dr. Lorenzo Grosvenor, of the Illinois Charitable Eye and Ear Infirmary, and the slides studied by Dr. E. V. L. Brown, who submits the following report:

Pathologic Examination.—Gross section shows: Antero-

posterior diameter, 2.4 cm.; cross-section, 2.5 cm. Bulb somewhat distended behind equator on one side, and sclera everywhere thinned. Cornea clear, pupil dilated to 6 mm. Anterior chamber everywhere obliterated by apposition of iris to the back of the cornea and in pupillary area by displacement forward of the fairly clear lens. Cataracta accreta shows on right-hand face of equator of lens. Left hand one-half of outer surface of sclera behind equator shows two rows of ten tiny solid black superficial pigmented flecks (connected with the emissaria?).

The retina is completely detached as a central strand running from the nerve-head straight forward to within 1 mm. of posterior pole of lens and then bellies forward against the back of the lens and thence laterally to a point opposite the scleral spurs. The retroretinal space is filled out by an opaque, light-brown coagulum, in which there are three areas of brick-dust-appearing substance, one well forward on the left-hand side, the other just anterior to the equator, and the third to the left of the middle of the detached strand of retina; this latter contains a large amount of dense black pigment. On each side of the disc there lie tumor masses entirely within the choroidea; the one on the right extends from the disc border one-half way (12 mm. long), and is 1½ mm. thick, brownish-black in color, and flecked with tiny areas of white. The mass on the left-hand side of the disc runs one-third the way forward and measures 10 by 1½ mm.; it is very little pigmented, but overstrewn by reddish, granular material; the long posterior ciliary artery on this side is cut through its long axis as it goes through the sclera, and its canal is distinctly brownish in color and leads directly into the tumor-mass. The optic nerve-head shows a translucent, reddish, fleshy, fleck-form change just behind the lamina, extending a little to the left-hand side, but in general the nerve-head seems to be on the same surface level as the inner surface of the sclera (beginning cavernous atrophy?).

Cut and stained specimens are submitted. The lamina cribrosa is in normal position, and indeed beginning cavernous atrophy is found just behind it and in its most posterior layers. The corneal epithelium shows slight keratosis of the outer layers and some irregular thickening and thinning of all layers. Bowman's membrane is everywhere intact.

The corneal lamellæ and fixed cells are regular and well preserved.

Descemet's membrane and its endothelium are normal; the anterior chamber is reduced to a narrow slit of less width than normal corneal epithelium, and filled by an albuminous and fibrinous coagulum. The iris is notably condensed and is quite nuclear-rich, but aside from a slight tendency for detachment, its pigment layer is normal.

The ciliary body and corona are much compressed and flattened down, but show no evidence of severe inflammation. The choroid is everywhere much compressed (formalin hardening). The detached retina is fused together by its inner surfaces, and its nuclear layers coalesce. The lens is cataractous.

The tumor masses on either side of the nerve-head are richly pigmented and everywhere overlaid by an intact normal lamina vitrea layer, but no other layer of the choroid can be made out. Cross and longitudinal sections of many old large vessels are scattered through the tumor. The tumor is, however, essentially poor in vessels and shows numerous areas of beginning necrosis. In the center of these areas there is often found an obliterated blood-vessel. The most actively proliferating areas are made up of cells arranged in "funiculi" (Fuchs); that is, longish, worm-like, finger-form, or convolutes of cells, in which the areas of cells are separated from each other by spaces or narrow lines of connective tissue or pigmented strands. Large areas are found in which the field is almost entirely occupied by large rounded balls of pigment. There are also short "garlands" of cells (Fuchs).

The necrotic areas are especially densely pigmented, and in these areas are found extensive nuclear fragmentation and diffuse eosin staining, and about them is frequently found a narrow zone of wandering leucocyte infiltration; many of the cells are polynuclears. No distinct areas of hemorrhage are to be found in the tumor-mass. The type of proliferating cell is a small, spindle-shaped variety. Most of the vessels of the tumor are obliterated. Sections going through the edge of the disc show the central retinal vessels to be girdled by a necrotic mass and show three small groups of cells in a broken line extending from the marginal disc-

tissue back through the sclera and finally into the nerve bundles proper.

Diagnosis.—"Flat" melanosarcoma of the choroid with extension through the sclera about and into the optic nerve; detachment of retina, followed by secondary glaucoma with beginning cavernous atrophy of optic nerve.

I saw this patient a few days before leaving home. She seems to be in good health, says she feels perfectly well, and there is no apparent return of the tumor in the orbit.

DISCUSSION.

DR. JOHN E. WEEKS, New York: These cases differ from the ordinary sarcoma of the choroid in two particulars, as a rule. They are of the alveolar variety, which means that they belong to the endothelial variety of sarcoma. They are flat because they have not penetrated the lamina vitrea. The reason we have the peculiar form of the sarcoma ordinarily is that the growth has penetrated the lamina vitrea, at which point it is constricted because of the pressure of the lamina vitrea on the growth. For some reason in alveolar sarcoma (or endothelioma) of the choroid the tendency to perforate the lamina vitrea is apparently not so great and there is a spreading laterally. I have examined one such case, but have not reported it. In regard to the perforation of the sclera by the growth, the cells do not always follow the perivascular sheath, but may enter the lymph-spaces and penetrate the sclera between the bundles of connective tissue; however, the usual route of extension to the extrascleral tissues is through the perivascular spaces.

SARCOMA OF THE EYE.

Report of Three Cases.

S. C. MAXSON, M.D.,
Utica, N. Y.

Case 1.—*Fibrosarcoma of the Ciliary Body.*—Ralph B., aged nineteen, a student, consulted me January 31, 1911, on account of dimness of vision of his right eye which interfered with his work. He had no pain in the eye. Vision, R. E. = $\frac{20}{40}$; L. E. = $\frac{20}{20}$. There was a passive congestion of the conjunctiva in the right eye; iris was normal in color; anterior chamber rather shallow. The most conspicuous point was a tumor projecting through the pupil at its upper margin about the size and color of an apple-seed. The iris did not appear to be involved in the growth. The tumor was entirely behind the iris, except at the pupillary margin. Here it projected forward into the pupillary opening and into the anterior chamber. Atropin dilated the pupil at all points except where the growth pressed upon the iris. The vitreous was somewhat cloudy, not giving a clear view of the fundus. One could, however, see the blood-vessels of the retina as through a cloud. There was no apparent disturbance with the circulation within the eye. The growth resembled in shape and color a specific node or vegetation. On the other hand, there was an entire absence of acute symptoms which accompany specific conditions, such as pain or active congestion. The pupil responded to light. Some lacrimation, but not excessive. There is absolutely no specific history obtainable. He is an orphan and paternal history not to be had.

I felt at the first that it was a malignant growth. Not being able to get any family history which would shed light upon the problem, I gave a very unfavorable prognosis.

This led the patient to consult my friend, Dr. F., an oculist of this city, who thought it might be tubercular in nature. The family physician, Dr. F., was positive that there was no tuberculosis in the case. I ordered mixed treatment for several weeks, but the growth materially increased in size. At the request of his family physician I sent him to another oculist, Dr. L., also of this city, who believed the trouble specific, and that the treatment had failed because it had not been pushed with sufficient vigor. I protested against further delay, but finally yielded, consenting to another two weeks of vigorous antispecific treatment. He returned at that time poisoned with mercury and iodids. The tumor had grown rapidly during this time and I refused to delay further. He now consented to the operation, and March 14th I did an iridectomy, removing all of the growth I could reach. It was very soft and crushed between the blades of the forceps. I was able to get enough for microscopic examination. The reaction was rather sharp. The specimen was given to our city pathologist, Dr. Church, who reported that the growth was unquestionably malignant. The tumor promptly returned and I enucleated the eye March 18th. He made an uneventful recovery and was discharged a week later. The enucleated eye was examined by Dr. Church, who found a fibrosarcoma, having its attachment and growth from the ciliary body. May 2d he returned for an artificial eye. The stump was healthy, and has remained so up to this time.

From my own experience and after careful examination of the authorities in my collection I am led to think that sarcoma of the ciliary body is very uncommon. In my experience of more than twenty-five years in the practice of ophthalmology this is my first case. De Schweinitz speaks of this disease as one having been described, and giving the conditions which I observed in this case, that in the early stage there was little disturbance of function. This is

conspicuous when we consider the gravity of the condition. Ball, in his late work, when enumerating the tumors of the eye, speaks of sarcoma of the ciliary body. This would lead one to think that he had no personal knowledge of this disease. Noyes and Bull give the best description of any authority I possess. Fuchs says that sarcoma of the ciliary body remains a long time hidden behind the iris. All agree that enucleation is the only known remedy.

CASE 2.—*Sarcoma of the Choroid.*—Mrs. B., aged sixty-eight, married, and the mother of children, consulted me May 11, 1911, complaining of pain in her right eye. On inspection I found the eye passively congested, with dilatation of the conjunctival veins, cornea hazy, and pupil partly closed with an exudate. There was increased tension, not very well marked. Vision, perception of light only. I advised the use of eserin and dionin. This gave her some relief, but soon the eserin became an irritant. She returned in about two weeks, complaining of intense pain in the eye. The tension was reduced, but the pain increased.

I thought I had a tumor to deal with and advised enucleation, which was refused. I then gave holocain for the pain. This failed to relieve her, and on May 29th I enucleated the eye. There was rather profuse hemorrhage. The recovery was uneventful. On opening the eyeball I found a tumor projecting into the vitreous about the size of the meat of a peanut. It was black in color. This was submitted to Dr. Church for microscopic examination and found to be a sarcoma having its origin in the choroid. At the present writing, eight months later, there has been no return of the growth.

CASE 3.—*Sarcoma of the Orbit in the Newborn.*—October 10, 1911, I was called to see a child just born at the General Hospital in this city. The child was poorly nourished and on its body there were sixty small tumors from the size of peanuts to that of the chestnut. There was complete

exophthalmos of the right eye, the eyeball being pushed out beyond the lids so that it was literally lying on the cheek. My first impression was that there might have been an intra-orbital hemorrhage in delivery, and with this possibility in mind I pressed the eyeball back and closed the lids over it, retaining the lids with stitches. These were removed the following day and the eye remained for some days behind the lids. The intra-orbital tumor continued to grow and the eyeball was again outside the lids, and finally it sloughed. The tumors on the body increased in size and the intra-orbital growth protruded between the lids. At one time there was a deep jaundice to the entire skin of deep yellow color. This finally subsided. During the time of the jaundice the child increased in weight. The child lived nearly three weeks.

The diagnosis was sarcoma of the orbit in utero. I have not been able to get the history of another case of this kind; namely, of sarcoma of the orbit in utero with complete exophthalmos.

DISCUSSION.

DR. R. A. REEVE, Toronto: The reader of the paper gives us, I think, one and a half years as the longest interval without recurrence. In a discussion upon sarcoma before this Society some years ago I reported a case of sarcoma of the orbit in which I had enucleated an eye for acute glaucoma without having had an opportunity of examining the fundus. The patient had cataract. Fully one-third of the vitreous chamber was occupied by a pigmented sarcoma. The patient recovered promptly, and there was no apparent trouble until he presented himself fourteen years afterward, when he had sarcoma of the orbit. I ventured the opinion that it was not a recurrence of sarcoma, but a development from a fresh center further back. I also reported a case of encephaloid, a large mass protruding from the orbit, in which I exenterated the orbit, destroyed the periosteum with chlorid of zinc paste, and entered the antrum. In this case the patient lived for at least twelve years, and there was absolutely no recurrence.

DR. JOHN E. WEEKS, New York: In regard to sarcoma of the ciliary body I would like to call attention to the fact that some of these cases have been described as tubular sarcoma. The cases of tubular sarcoma are really, so far as I have been able to ascertain, carcinoma of the ciliary body springing from the epithelial layer of that body. The so-called tubular sarcoma really belongs in the class carcinoma. In this connection I would like to refer to a specimen that I have brought here this morning, a case of sarcoma springing apparently from the choroid, but in which the pigmentation is apparently derived from the pigment layer of the retina. The specimen is under the microscope. The growth measured 1 mm. by 1.5 mm. by 0.5 mm., and is the smallest sarcoma reported for which the eye has been removed, so far as I am aware. The tumor appeared at the macula and was brought to the attention of the patient on account of the production of a very nearly central scotoma. The patient came under my observation about four months before the eye was removed. A careful study of the size of the scotoma and the relation of the blood-vessels to the growth was made. The possibility of syphilis and of tubercle was considered and these causes eliminated. At the end of three months the relation of the blood-vessels had changed and the scotoma had enlarged, indicating a growth in a certain part of the tumor. I advised enucleation, which was done.

A CASE OF PRIMARY INTRADURAL TUMOR OF THE OPTIC NERVE.

WILLIAM M. SWEET, M.D.,
Philadelphia.

Primary intradural tumors of the optic nerve are of sufficient rarity to warrant the presentation of the following case:

On October 18, 1911, I saw, in consultation with Dr. A. Alonzo Sargent, George M., aged thirty-three, a bituminous-coal miner, who had exophthalmos of the left eye. He gave a history of having been struck in the eye three years ago by a lump of coal. For a week or more afterward there was some edema of the lids, but he claims that the eyeball was not injured and that the sight was unaffected. It was not until over a year after the accident that he first noticed slight dimness in vision, which gradually increased until all perception of light was lost. He says that the protrusion of the eyeball commenced about ten months before I saw him and slowly increased. There had never been any distinct pain, only a sense of fullness in the orbit and the discomfort from the effort required to bring the lids over the prominent globe. There was nothing in the family history or in his previous medical history bearing upon his present trouble. He had the usual affections of childhood, but never had any severe illness nor injury to the head during early manhood. He was a tall, robust individual, well nourished, and did not suffer in his general health from the ocular trouble.

Ocular examination showed: R.E., V. $= \frac{6}{6}$, normal in all respects, refraction, low myopic astigmatism. L.E., no l. p.; pupil, 5 mm., no reaction to direct light; media clear; optic disc grayish-white in color, with no evidence of previous swelling; retinal arteries small; veins full and tortuous. The eyeball was turned slightly upward and

inward, with limitation of downward and outward rotations. Hertel's instrument recorded: R.E:, 14 mm.; L.E., 29 mm. (See Fig. 1.) There was no bruit, and palpation failed to show any distinct orbital growth. It was impossible to reduce the exophthalmos by pressure. The tension of the eyeball was normal, the cornea clear, but the conjunctiva considerably thickened and edematous. Refraction: hyperopia, +2 D. with the ophthalmoscope.

Examination of the nose, throat, and sinuses by Dr. J. S. Gibb was negative. Dr. H. F. Hansell made an examination with the ophthalmodiaphanoscope, and reported that all the sinuses were brightly illuminated. With the instrument in the mouth the light traversed the antra, passed through the floor of the orbit, through the anterior ethmoidal cells, and illuminated the tissues around the ball and the interior of the eye, indicating no large or dense tumor in the anterior part of the orbit obstructing the light as it was transmitted to the observer. No opportunity was afforded for making stereoscopic Roentgen-ray plates, as operation had been arranged at a special clinic the day following the examination.

Operation under ether. An exploratory incision was made through the outer upper orbital margin, and the finger, passed back of the globe, outlined a rounded mass springing from the optic nerve a short distance back of the eyeball. So completely did the growth fill up the apex of the orbit that it was difficult to separate it from the surrounding tissues. As the tumor was too large to be removed through the incision made in the brow, and it was believed that removal of so large a tumor by resection of the external orbital wall with preservation of the globe would later have been followed by enophthalmos, the eyeball was removed, together with the growth. The posterior end of the tumor was close to the optic foramen. Healing was uneventful.

Dr. A. A. Sargent, of the Polyclinic Hospital, prepared the specimens and examined sections from various portions of the tumor and the eyeball. Dr. A. G. Ellis, of the Jeffer-

Fig. 1.

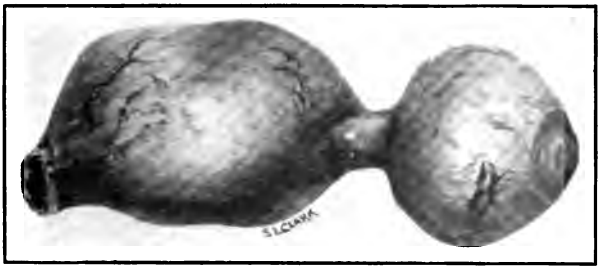

Fig. 2.—Eyeball and tumor. Full size.

son Medical College, also stained and examined sections of the tumor.

Macroscopic Description.—The tumor was irregularly pear-shaped, having a greater and a lesser curvature when viewed from the side (Fig. 2). When viewed from above downward, its figure was asymmetrical, being less in width at the end nearest the eyeball. It was connected with the eyeball by the optic nerve, which was 7 mm. in length on one side and 5 mm. on the other, and 7 mm. in diameter, exceeding by 2 mm. the normal nerve.

The measurements of the tumor were as follows: From side, length, 39 mm.; breadth at center, 25 mm.; at 9 mm. from anterior end, 22 mm.; at 10 mm. from posterior end, 24 mm. From above, length, 39 mm.; 11 mm. distant anterior end, 18 mm.; at 23 mm. distant, 23 mm., and at 33 mm. distant, 20 mm.

It presented a smooth and glistening capsule, which was continuous with the dural sheath of the optic nerve at each end. This capsule was not adherent to the underlying mass, and was apparently about 0.5 mm. in thickness throughout.

In consistence the tumor was soft, and on palpation gave the impression one would receive when palpating a bag filled with earth-worms. Transverse section of the tumor, about 10 mm. from its posterior end, failed to show the presence of the optic nerve.

In color the mass was reddish-brown, and resembled, for the most part, irregular clumps of coagulated blood between which were irregular trabeculæ of a light gray color. These trabeculæ were continuous with a layer of tissue lying immediately beneath the capsule. The layer of tissue was irregular in thickness, measuring from 1 mm. on one side to 3 mm. on the other, and from that point gradually increasing in thickness until it became lost as a distinct layer and blended with the central substance of the tumor.

Longitudinal section of the tumor showed, in the posterior half, that the trabeculæ from the layer beneath the capsule became continuous with three well-marked rings of fibrous tissue inclosing what appeared to be coagulated blood. The

walls of these rings were quite regular in outline and about 2 mm. thick.

The anterior end of the tumor showed a large, imperfect ring of fibrous tissue lying immediately beneath the subcapsular layer. This ring was divided anteroposteriorly by an irregular mass of fibrous tissue 6 mm. in width.

The two cavities thus formed contained a substance similar to that inclosed in the rings occupying the posterior part of the tumor. At no part was the optic nerve apparent macroscopically.

Microscopic Description of the Tumor.—The cover of the tumor is externally a band of fibrous tissue with coarse, somewhat wavy fibrils—the dura. Beneath this is a broader band of fibrous tissue, less dense, composed of finer fibrils, and staining less deeply than the dura, and evidently of more recent formation. The innermost zone of this band has a rather definite separation from the outer part in areas and is slightly more dense. This entire band of fibrous tissue is vascular, at points extremely so, and among the red cells in many of the spaces are masses of brownish-yellow pigment, some apparently within cells, others extracellular.

The growth proper is in general terms made up of a cellular reticulum and innumerable blood-vessels or, in some areas, blood-channels. The cells are partly of the lymphoid type, partly larger, with palely stained nuclei and resembling endothelial cells. Some of the latter are oval in shape; all are mononuclears. These cells are rather loosely placed, being in a more or less prominent meshwork of very fine fibrils which stain an indifferent yellow by van Gieson. The fibrils at points inclose spaces which at first sight appear to be adipose tissue; close inspection fails to confirm such view, though the resemblance in areas is very striking.

The blood-vessels or channels are of all sizes, from capillary-like vessels up to large, irregular, cyst-like spaces only partly filled by red cells. The smaller possess walls of endothelium only. The larger have walls of hyaline fibrous tissue lined by endothelium, and in some instances quite thick. The peripheral part of the hyaline fibrous tissue is rich in cells of the larger type already described, and fades

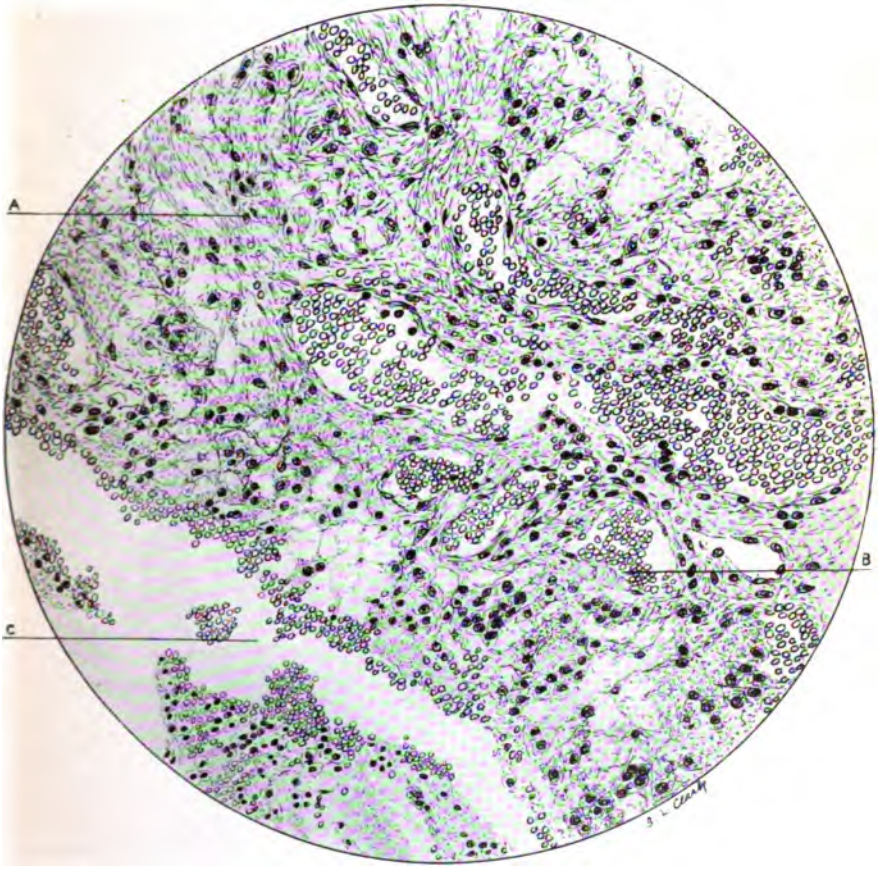

Fig. 3.—Primary intradural tumor of optic nerve: A, Cellular, slightly fibrillar, matrix of tumor; B, small blood-vessel with undifferentiated wall, of the type numerous throughout the growth; C, large space bordered by red blood-cells. Such spaces are frequent in the tumor and appear to be vascular channels. (B. and L., ⅛ obj., oc. 5.)

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off gradually into the cellular reticulum before mentioned. Some of the smaller or medium-sized vessels course through the reticular areas bounded by no demonstrable wall, and yet possess the regularity of vessels so limited. The large spaces appear to be areas of hemorrhage, yet the red cells in them are as well preserved as are those within the definitely bounded channels. In many areas red cells inundate the reticulum. Small masses of pigment, as described in connection with the inner layer of the capsule, are scattered through the red-cell collections. True differentiated blood-vessel walls are found only in the capsule, although a few of the largest in the tumor have rather densely staining fibrous tissue instead of the hyaline variety described. A true fibrous tissue reticulum, or stroma, of the tumor is lacking. Sections stained by Mallory's method fail to show the presence of neuroglia.

The eyeball was distinctly flattened at its posterior pole. The scleral vessels were distended with blood. At several places there were regular masses of fibrous connective tissue extending outward from the superficial layers of the sclera. These were composed of irregularly arranged bundles of wavy fibers, and in some instances inclosed distended blood-vessels. The internal structures showed the blood-vessels everywhere greatly increased in size and engorged with blood.

Both Dr. Ellis and Dr. Sargent recognized fully the difficulty of properly classifying the tumor in this case. Dr. Ellis regarded the histology as excluding it from the group of malignant tumors. The architecture seemed to him to most nearly approach that of an angioma. On the other hand, Dr. Sargent considered the growth to be a fibrosarcoma, owing to the character of the cellular structures and their preponderance over the interstitial elements, the arrangement of the blood-channels and pigment, and in some sections the hyperplasia of fibrous tissues in different stages of organization, in which the cellular elements were relatively low.

The exact nature of tumors of the optic nerve has been

the subject of much discussion, the complex picture presented by various parts of these growths leading to many classifications by different observers. The sections of the tumor from the case here reported well illustrate the essential characteristics of these optic nerve growths. In some portions the cellular arrangement and pigmentation closely resemble a myxosarcoma, while others exhibit the connective tissue growth with comparatively few cellular elements of the fibromata. Byers, in an analysis of the reported cases, considered that these tumors did not correspond to any one special type of growth, but that there were represented in the same specimen several phases of connective tissue development. He therefore compared them to the changes which occur in the subcutaneous tissue in elephantiasis, and employs the term fibromatosis to indicate the essential connective tissue overgrowth of the tumors. He believed that they do not belong to the class of myxosarcomata or fibrosarcomata, or there would be secondary manifestations. The fact that these growths do not recur in the orbit, notwithstanding the frequent instances of incomplete removal, would seem to indicate their non-malignant character. The glial nature of the tissue found in many of the optic-nerve tumors could not be demonstrated in the laboratory examination of the sections in the case here reported.

Dr. Byers kindly examined sections of tumor from this patient, and considered that the growth corresponded in general characteristics with those studied by him, and that it belonged to the ill-defined class of connective tissue overgrowth.

The subject of primary intradural tumors of the optic nerve has been so thoroughly treated by Byers and by Parsons that it is not necessary to review the literature at this time. These growths are uncommon after the twenty-fifth year, most of them occurring in early life, and probably often congenital. There is not infrequently an

associated systemic disturbance. As this patient was thirty-two years of age at the time the tumor first affected sight, the case belongs to the rarer forms of growths of this region. Byers, in his summary of 85 cases, reported only 4 which occurred after the twenty-fifth year, and only 9 in which there was a history of injury. In most of the cases the diagnosis of an optic-nerve tumor is often possible from the downward and outward direction of the proptosis, according to von Graefe's rule that the protrusion follows in the line of the axis of the orbit. In only 2 of the 63 cases analyzed by Byers in which the direction of the proptosis is given, was the eyeball turned upward and inward, as existed in this patient. A greater limitation of rotation of the eyeball might have been expected from the pressure exerted by such a large tumor and the degree of the exophthalmos, although the length of the unaffected portion of the optic nerve permitted free movement of the globe.

There has been no recurrence of the growth in one year since the operation. The patient is enjoying excellent health, and wears an artificial eye with comfort.

Since the presentation of this paper, an exhaustive study of primary tumors of the optic nerve has been made by A. C. Hudson,* with the purpose of classifying the reported cases, based on the histological features. He divides the recorded cases into three groups: In the first group, which includes the greater number of cases, are the tumors met with usually in young subjects; they are of slow and painless growth, and the new tissue lies within the dural sheath, and in the majority of cases is not limited to the orbital portion of the nerve, but extends into the cranial cavity more or less extensively. The cells usually have a round or oval nucleus and long or spinal processes, sometimes with club-shaped extremities containing hyaline masses. Between the cells is often found a material of mucinous appear-

* Royal London Oph. Hosp. Rep., vol. xviii, p. 317.

ance, apparently a product of degeneration of the cell processes, often occupying large areas of the tumor. In many of the tumors the tissue of the growth becomes organized into a more or less compact fibrillated material. The blood-vessels may be scanty or present in great numbers, and frequently exhibit hyaline degeneration of their walls. The suggested classification of this group of tumors is gliomatous degeneration.

In the second group are the cases in which the most characteristic feature of the tumor is an enormous development of fibrous tissue, involving the outer sheath of the nerve. The changes in the nerve itself have been those attributable to atrophy from pressure or interference with nutrition. To this class of tumors the term fibromatosis is given, as representing a diffuse process of growth.

In the third group are placed the endothelial tumors of the optic-nerve sheath, the tumors presenting a close histological resemblance to the endothelial tumors of the brain membranes, being composed of masses of typical endothelial cells, supported in a usually scanty connective tissue.

DISCUSSION.

DR. HOWARD F. HANSELL, Philadelphia: I would like to speak for just a moment about the value of the ophthalmodiaphanoscope in diagnosis of conditions of the orbit or interior of the eye and in the sinuses. This instrument consists of a lamp, surrounded by a current of water, and of a power of 80 candles, magnified to 100 candles by a mirror that covers half the lamp. The lamp is introduced by the patient into the the mouth as far back as is possible, and the light is so strong that the sinuses are perfectly illuminated—better than by any other instrument that I know. If there is any obstacle, such as blood or a more solid substance, it is immediately shown. The lamp is kept fairly cool by the water, but it cannot be kept in the mouth more than a minute or a minute and a half at a time.

It has appliances for illumination of other cavities of the body. In the case reported by Dr. Sweet the illumination of the anterior half of the orbit and in the eyeball was perfect, indicating that if a tumor were present it must be located far back in the posterior half of the orbit.

A CASE OF PLEXIFORM NEUROFIBROMA INVOLVING THE ORBIT.

W. ZENTMAYER, M.D.,
Philadelphia.

Plexiform neurofibromata are of unusual occurrence, and involvement of the orbit by the growth is very rare. Among the 56 cases tabulated by Thomson there were but three in which this occurred.

The following case was sent to me by Dr. James K. Young, to whom it had been referred by Dr. E. F. Neff, of Altoona, Pa.:

E. N., female, aged three and one-half years. The child is hydrocephalic and poorly nourished. In July, 1910, she fell, striking the head in the frontal region. One week later a swelling made its appearance in the left temporal region. Drooping of the lid was first noticed some months later following an attack of whooping-cough. Two weeks after the fall she had a sick spell of short duration accompanied by high fever. The patient is the youngest of seven children. One is dead of spinal meningitis; the rest are in good health.

Examination shows a hemispherical mass, about 5 cm. in diameter in the temporal region, with a narrow extension across the rim of the orbit and a prolongation between the globe and the roof of the orbit to the apex. The mass feels like a bundle of knotted cords. The globe is displaced slightly downward and forward. There is no buphthalmos. There is moderate ptosis. The skin over the involved area is hyperemic.

A diagnosis of plexiform neurofibroma was made, and at the suggestion of Dr. Young a fragment of the growth was removed for microscopic examination. The clinical diagnosis was confirmed.

A few days later, with the assistance of Dr. Posey, the removal of the growth was undertaken. The incision made to remove the main mass was extended into the lid. The growth was only in part dissected out, as strands of tissue were found ramifying into the muscles of the forehead and cheek. A vermiform cord which extended from the rim of the orbit backward apparently to the very apex was removed.

Etherization was badly borne. Although twelve hours after the operation the child was apparently in good condition a few hours subsequently the temperature suddenly rose to 104°, respirations to 80, and pulse to 160, and death occurred twenty-eight hours after the operation. Dr. James E. Talley who was called in thought the condition suggested a toxemia. No autopsy was made.

Macroscopically the growth consisted of a mass of fibrous and fatty tissue pervaded by varicose semitranslucent cords.

The report on the specimen by Dr. Harold G. Goldberg, pathologist to Wills Hospital, is as follows:

Macroscopy.—The specimen is in nine parts, varying in size from 12 to 5 mm. to 7 to 3 to 2 mm. The growth is reddish in color, and seems to contain a considerable amount of fibrous tissue. This forms the principal substance, and incloses within its meshes characteristic cylinders of pale, glistening, fatty looking tissue, vermiform in appearance, avascular, and varying in caliber from 3 to 9 mm., and in length appearing as long as 4½ cm. This last seems to be the distinctive feature of the growth and is plentifully distributed throughout the entire mass. The cylinders are easily separated from the surrounding tissue, in which they appear to have been encapsulated. The capsule is a fasciculated fibrous sheath.

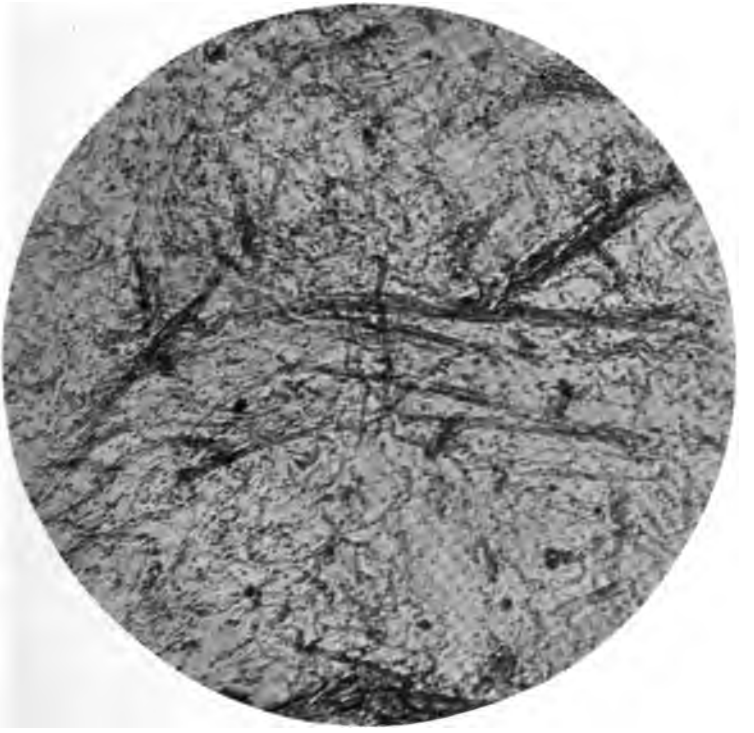

Fig. 1.—Neurofibroma, showing a thickened perineurium; an increase in the fibrous tissue elements of the nerves; isolated nerve-fibers in the fibrous tissue; varicosities and degeneration of the nerve-fibers.

Microscopy.—The principal substance of the growth is composed of actively proliferating fibroconnective tissue. The structure of the mass is best described by saying that it is vesicular in character. The spaces are surrounded by the more robust elements, the whole contributing to the vesicular contents. These areas are of two types, the walls the same in both; the contents of one is fatty tissue, and in this case there is a considerable irregularity as to the size of the walls, the form, and the outline; in the other, the spaces are generally larger, the walls more regular, and the grouping more complex. The contents of the spaces are chiefly nerve tissue, both supporting elements and nerve-fibers, arranged occasionally not unlike ganglia. In some places the fibers are medullated, but most of them would indicate nerve-endings. There seems to be an equal interchange between the space contents and the walls. These walls are plentifully supplied with lymphatics. Typical fibromatosis is seen everywhere. Where the fibers are unretained they are scattered irregularly throughout the field; we see both nerve-fibers and endoneurium. The proliferation of the fibrous tissue elements is fibrillar in character and not homogeneous, as is sometimes seen. There are no apparent degenerations, and all of the tissue seems to be well nourished. The blood-vessel aspect is very interesting; there is an enormous enlargement of the adventitia and perivascular lymph-sheaths, while the endothelium appears to be normal. The grouping of the so-called vesicular spaces may be an attempt at complex nerve construction; if this is true, the epineurium is about normal, and the proliferation is apparently confined to the peri- and endoneurium. Sections through the characteristic nerve bundles described above show typical funiculated nerve cords. The proliferation of the fibrous tissue elements is enormous; the fibers vary in length from about one-half to three-fourth field diameters. Some present varicosities; some are segmented; most of them are supplied with lymphatics.

The photomicrograph (Fig.1), made by Dr. N. M. Brinkerhoff, clinical pathologist to Wills Hospital, shows the characteristic features of the tumor.

At the request of Dr. Goldberg, Dr. Allen J. Smith was

asked to pass on the specimen, and he has kindly furnished a report, which in abstract is that there are present both medullated and non-medullated nerve-fibers ramifying in an irregular way in the midst of fine fibrillar connective tissue and fat, the general stroma containing numerous red blood-corpuscles and young connective-tissue corpuscles. The growth is moderately vascular; the blood-vessels are of both capillary and well-formed arterial type. In most places it is difficult to separate the nerve-fibers from elastic tissue fibers, but in the best portions there can be found in cross-section a regular medullary piece with central axial fibers. Moreover, the non-medullated fibers are too slender and too straight to be mistaken for elastica of any form. The diagnosis is therefore fibroneuroma.

DISCUSSION.

DR. C. H. BEARD, Chicago: I do not know whether Dr. Zentmayer has found the case I reported in conjunction with Dr. E. V. L. Brown, giving the pathology anatomy, in Knapp's "Archives," of plexiform neurofibroma in a man thirty-five years old. The main tumor was in the orbit of the right eye, extending pretty well back to the apex, above the eye, and involving the supraorbital nerve. There were characteristic nodules feeling like bunches of fiddle-strings all around the distribution of the fifth nerve. Aside from the downward and forward displacement of the globe, and beginning strangulation of the retinal circulation, there was no disturbance of the eye itself. There was a ptosis and a peculiar pigmentation of the skin of the lid, which has been described by several in connection with plexiform neuro-fibroma.

DR. W. ZENTMAYER, Philadelphia: I made no attempt to search the literature. Dr. Brown was kind enough to send me a reprint of the case that he reported. I simply took Thomson's collection, which is now some ten years old. There have been several cases since reported, one very elaborately in the Klinische Monatsblätter, in which there was also buphthalmos.

A CASE OF ENDOTHELIAL SARCOMA OF THE ORBIT.

JOHN E. WEEKS, M.D.,
New York.

Mrs. George W. C., aged thirty years, consulted me at my office March 24, 1904. One year previously patient had sustained a severe blow on the left side of the head. About two months later the patient noticed a blurring of the vision of the left eye and halos about lights. Could see equally well with both eyes before the accident. Thinks that recently the vision has improved somewhat.

Status Præsens.—Left eye slightly more prominent than right. Pupils of equal size. Irides react normally. R. E., Tn.; L. E., Tn.+. Movements of eyeballs normal in extent. Orthophoria. Vision, with correction of the error of refraction, R.E., $\frac{20}{30}$; L.E., $\frac{20}{30}$. Slight paleness of optic disc, left eye. The field of vision presents a small paracentral relative scotoma (Fig. 1), color sense very defective in this eye. Glasses were given for the correction of the error of refraction, and the patient was advised to report again if the vision of the left eye did not improve.

Patient was not seen again until December 11, 1911, when she stated that the vision of the left eye had slowly failed and that the eyeball had gradually become more prominent. No pain; no discomfort.

Status Præsens.—Right eye as before. Left eye V. = 0. Eyeball pushed forward and a little downward, about 7 mm. in advance of the right eye. Movements limited in all directions about equally. Optic disc presents a condition of simple atrophy. There was quite marked evidence of venous congestion present in the tissues of the orbit and eyelids. Headache this morning, but not before for years.

Transillumination of accessory sinuses negative. *X*-ray skiagraphs were taken by Dr. Caldwell. These showed a shadow which apparently indicated a hard mass, possibly bony, projecting into the orbit, involving and projecting from the greater wing of the sphenoid and the outer margin of the orbital plate of the frontal bone, extending from the apex two-thirds of the distance forward toward the margin of the orbit. Operation was advised.

February 8, 1912, the patient was admitted to the New

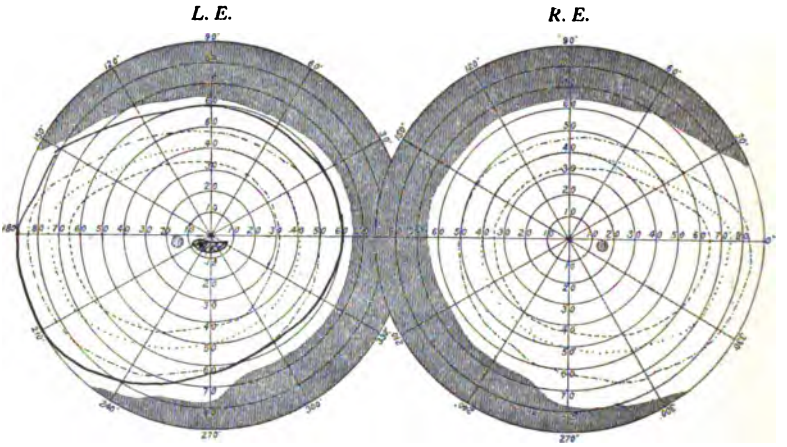

Fig. 1.—Small paracentral relative scotoma, left eye.

York Eye and Ear Infirmary and a Krönlein operation performed. The classical incision was made but, because of unusual thickness of the tissues, a straight incision on a level with the lower margin of the eyebrow was extended forward from the original incision about three-fourths of an inch. The incision was carried to the periosteum just posterior to the margin of the orbit, the periosteum divided a few millimeters outside of the margin of the orbit and raised from the orbital surface well back toward the apex. It was found that the division of the bony margin of the

orbit, in making the bone flap, was facilitated by using small, straight, rigid bone saws. After the wedge-shaped piece of bone was reflected backward the orbital periosteum was slit equatorially, and the contents of the orbit exposed. Great difficulty was experienced in recognizing a tumor: finally, a small dark-red mass first made out by Dr. Reese, who kindly assisted, was recognized occupying the apex of the orbit. This mass was firm, elastic, wedge-shaped (almost conical), measuring about 10 mm. in diameter at the base, 12 mm. from base to apex, the apex being at the apex of the orbit. It pressed upon the optic nerve and occluded the inner angle of the sphenoidal fissure. By blunt dissection apparently the entire tumor was removed in what appeared to be a more or less complete capsule. The tumor mass was not broken. No other tumor mass could be found. However, it was thought possible that there might be an extension of the growth backward. In the search for the tumor considerable traumatism was done to the orbital tissue, but none of the ocular muscles were divided and the optic nerve and globe remained intact. As the orbital lacrimal gland had been partly dislocated, it was excised. The deeper tissues were sutured with catgut; the outer wound with silk sutures. Considerable edema of the lids and some chemosis followed, but union by first intention resulted, and at the present time the globe has receded almost to the normal and the movements are but slightly restricted. There appears to be sufficient moisture to adequately lubricate the eye without the orbital portion of the lacrimal gland. However, while still bandaged, a vesicular keratitis developed which at times resembled filamentous keratitis, and this has appeared from time to time since. The eruption of vesicles is accompanied by some irritation and pain, not severe, which lasts a day or two and disappears. The tumor was sent to the laboratory at the infirmary, where it was examined by Dr. George S. Dixon and by myself. It

presents the characteristic appearance of endothelial sarcoma.

The points of special interest in the case are:

1st. The slow development of a tumor following a history of traumatism.

2d. The small size of the tumor to cause such a decided exophthalmos.

3d. The difficulty of properly interpreting skiagraphic plates.

In regard to the traumatism, there is a history of an appearance indicating hemorrhage into the orbit and ecchymosis of the eyelids on the left side. Sarcoma following traumatism affecting the orbit is, of course, well known.

In regard to the exophthalmos, this is explained only on the apparent fact that the venous flow into the cavernous sinus was obstructed. The venous congestion of the tissue of the orbit and to some extent of the tissue of the eyelids points to this as the explanation. The size of the tumor could not possibly have produced such a marked protrusion of the eyeball.

The skiagraph certainly indicated the presence of a mass that obstructed the *x*-rays in the upper outer posterior two-thirds of the orbit. The fracture of the outer wall of the orbit, on completion of the bone-flap, disclosed the fact that the bony plate was a little thicker than is ordinarily met with, but there was no evidence of a mass such as the plates led us to expect.

DISCUSSION.

DR. DUNBAR ROY, Atlanta: Last year I operated upon two orbital tumors, one, a fibroma, about the size of an almond, the other an angioma. After a diagnosis of the tumor had been made—there being proptosis and decided protrusion downward and outward—I decided to go in along the upper orbital ridge, and was surprised with what ease the tumors could be removed in that manner. It does

not matter how large they are if you make the incision large by starting at the supraorbital notch and carrying it around to the external portion of the orbital ridge. When you get into the orbital fat with your finger there is no trouble in peeling out the tumor. The fibroma was extradural and attached to the outer side of the optic nerve. There was complete atrophy of the optic nerve. Both of these tumors were removed without any difficulty whatever, and both eyes took their normal appearance again, and up to the present time the patients, with the exception of a slight ptosis, show very little indication that anything has been done. The incisions heal readily, and I really think with tumors in the orbital cavity that we can go into the cavity and remove these growths without doing any very large major operation, and I was surprised with what ease these tumors could be removed and what excellent results you had in preservation of the eyeball and the general appearance.

DR. JOHN E. WEEKS, New York: There are two points that I want to speak of. One is the appearance of paracentral scotoma from the pressure on the optic nerve that this tumor evidently exerted, or that was exerted by the blood that had passed into the orbital tissue. It is to me very peculiar that such a scotoma should develop, although, of course, it is perfectly well known that such scotomata do develop from pressure from inflammatory masses consequent upon diseases of the posterior ethmoidal and sphenoidal sinuses. The pressure in this case undoubtedly affected the entire macular bundle; however, the nerve-fibers to the fovea centralis itself were but slightly involved, as the vision was $\frac{20}{30}$.

The accessibility to the contents of the orbit from the procedure proposed by Dr. Roy would not be as complete as one gets from the Krönlein operation. Such a tumor as I have reported could not have been reached by an opening into the orbit, such as Dr. Roy describes, since it was with the greatest difficulty that we recognized this tumor, even when the contents of the orbit were fully exposed. The dimensions of the tumor were 1 cm. at the base and not more than 1½ cm. in its longest diameter, and it was situated directly at the apex of the orbit, pressing on the optic nerve and occluding the inner angle of the sphenoidal fissure.

A CASE OF CHLOROMA.

ROBERT SATTLER, M.D.,
Cincinnati, Ohio.

The rapid-growing tumor masses of chloroma and the similar but chronic lymphomata make up a smaller group of the more uncommon neoplasms of the orbital cavities. For the latter, or lymphomata, chronic expressions of leucemia and pseudo-leucemia are tacitly admitted, but for chloroma, even with the next to constant presence of an acute and even vicious leucemia, this cannot with equal probability be assumed.

Chloroma shows an unmistakable predilection for the bony framework of the orbit, and its earliest positive declaration may first be discovered here, and, furthermore, be characterized by a bilateral and more or less symmetric growth. Chloroma supersedes all other tumors of this category in malignancy and an inexorable course.

In the present case the orbits were also early and dominant expressions of this uncommon lesion, and extreme rapidity of growth of the subperiosteal neoplasms in both cavities and of the adjacent temporal and frontal regions was from the first in conspicuous evidence. A mild leucocytosis was transformed within a short time limit into the most vicious leucemia.

Amid symptoms of excessive prostration, occasional epistaxis, uncontrollable backache and chest pains, as rapidly followed by increasing exophthalmos which as speedily precipitated sphacelation of both corneas and complete destruction of both eyes, we witnessed a striking clinical picture. This was again only equaled by a similar amaze-

ment, when the gross pathologic findings with their multiple green tumor masses and flat or medallion-like, pea-green infiltrations scattered throughout the pericranium, dura, spinal column, sternum, and internal organs were disclosed to us at the postmortem examination. These flattened, irregularly ovoid, and rounded greenish deposits projected but little over the surface in the localities in which they were found.

The following synopsis of the history refers only to the principal features of its rapidly lethal course and the gross and microscopic pathologic findings of the autopsy.

The patient, a lad aged eleven, whose parents attributed the beginning of his malady to getting chalk dust into his eyes at school, had first complained, three weeks before, of an unpleasant scratching and dryness of both eyes, but there was no impairment of vision or other objective disturbance. There were but two points noteworthy in his previous history: he was deaf and had a slight fetid discharge from the right ear, which had persisted after an attack of scarlet fever several years before. There was present also a slight enlargement of the thyroid, but at no time previous or at present were there other evidences of exophthalmic goiter. About two weeks prior to his visit to me, prominence of both eyes was first discovered, and also symmetric tumor masses in both lids and orbits. The boy complained little, but he was languid, irritable, and tired easily. Shortly afterward, or about three weeks from the beginning of his persistent ocular complaints, Dr. Petit, his physician, brought him to me for consultation. At that time, May 28, 1911, we found small symmetric, smooth, ovoid tumors in both orbits, and their location left little room for doubt that they were the displaced and enlarged lacrimal glands. The upper lids were smooth and tense and of a dusky hue; the palpebral fissure was horizontally narrowed. Both eyes were displaced forward, but the protrusion was not marked nor was the lateral displacement inward pronounced. He had perfect vision in both eyes and the eye-grounds were normal. There was no enlargement of the lymphatics,

either superficial or deep, adjacent or remote; there was present, however, symmetric enlargement of both parotid and the salivary glands. The tumor masses near the orbital margins and the adjacent temporal, parietal, and frontal regions imparted on palpation an elastic and nodular sensation.

Lacrimation was slight and could not be increased even through pungent odors, ammonia, or onion juice. He complained of dryness of the mouth, throat, and nose, but neither vigorous mastication nor astringent substances increased the flow of salivary secretion. The symmetric enlargement of the lacrimal and salivary glands, identical in structure, anatomically, led me at first to look upon the case as an early stage of Mikulicz disease. To obtain greater certainty, the right orbit was explored, and this conclusively established that the gland in question was indurated and dislocated. A piece was excised and a section showed a pale color and firm consistence and little or no bleeding. Microscopic examination pronounced it sarcoma.

The photograph marked 1 was taken May 28, 1911, and the one marked 2, June 17, 1911.

The greater swelling of the right side at this time was not alone due to the incision to explore the orbit, but to a recent more rapid growth of the subperiosteal masses of this region which could now be distinctly felt.

The time interval from May 28th to June 17th changed the clinical aspect completely. Mikulicz disease was, of course, ruled out. The rapid advance of the subperiosteal neoplasm, filling the apex and walls of both orbits, had caused greater displacement of the lacrimals, and the excessive proptosis had resulted in complete sphacelation of both corneas. The more or less symmetric subperiosteal tumor masses of the skull assumed, from this time, a distinctly nodular appearance and were more elastic to the touch. They now involved almost the entire vault of the cranium, and, though more or less symmetric during the later stage, were more marked or prominent on the right side. The suffering from this time was intense and constant. Prostration excessive. Chills and febrile activity fluctuated with increasing severity. Pains in the back and sternal region intense and constant and not relieved by anodynes. Amid increasing exhaustion, he died August 11, 1911.

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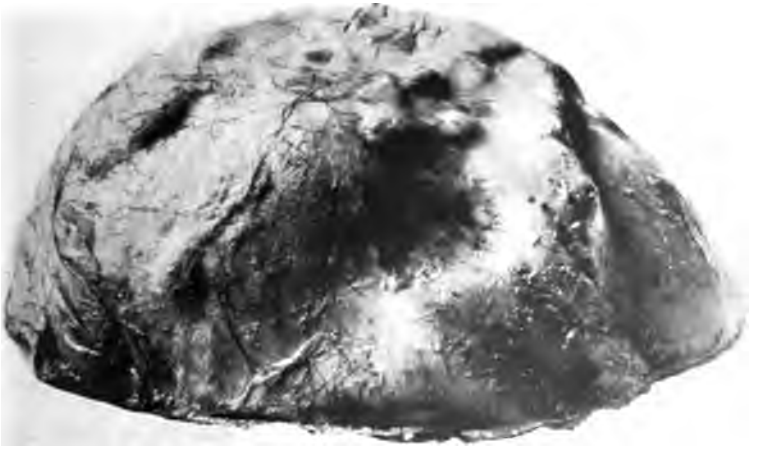

A case of chloroma.

AUTOPSY BY DR. H. W. WOODWARD.

Body that of a well-developed boy of eleven years, much emaciated, abdomen prominent, skin atrophic and glossy.

Both eyes pushed forward and downward by large tumor masses, the eyeballs collapsed.

Chest.—On removal of the sternum, a flat tumor mass was found adherent to its surface. This filled the entire mediastinum. This mass was very firm and, on section, of a pale green color. The pericardium, both parietal and visceral, was studded with small, flat tumors of the same type as the one described. The heart was small and flabby. Both pleural cavities contained muddy colored fluid, especially the right, and both layers of pleura contained similar tumor masses up to an inch in diameter. The lower lobe of the left lung showed hypostatic pneumonia. The right kidney was in a condition of pyonephritis due to obstruction of the ureter by a tumor mass at the hilum.

The kidney capsule showed many flat tumor masses projecting from the parenchyma. Left kidney same as right except for the absence of a distended pelvis. Lymph-nodes in general showed no enlargement.

Head.—There are large symmetric masses of tumor growth extending from the orbital tumors backward and upward over the temporal and parietal regions of the skull, apparently under the periosteum, and smaller masses involved and covered the sutures of the entire cranium. The dura mater was also found to be studded with tumors, all very flat and making no depression in the brain proper. The brain itself and the cranial nerves were free. The left lobe of the thyroid was much enlarged, but on section showed a typical colloid appearance only. Specimens removed from the orbital tumor had the same firm consistency and greenish color.

MICROSCOPIC EXAMINATION OF TUMOR MASSES BY GEORGE H. KNAPP, M.D.

The newly formed tissue is of a light green color and of firm consistency. Sections for microscopic examination were made from the substernal green tissue, from the tumors in the orbital cavities, and from the thyroid glands.

The tissues examined microscopically were fixed in formalin, the chloromatous tissue was stained with hematoxylin and eosin, by van Gieson's method and with Ehrlich's triacid stain; the thyroid sections were stained with hematoxylin and eosin.

The green tissue consists of small cells resembling leucocytes closely packed together, with a very delicate reticulum which is scarcely discernible in the sections stained with hematoxylin and eosin, but is plainly demonstrable in those stained by van Gieson's method. Here and there between the cells there are open spaces which evidently were blood channels, as many of them contain broken-down red corpuscles. No eosinophilic granulations were demonstrable in the cells of the sections stained with Ehrlich's triacid stain.

Examination of the sections of the thyroid gland shows that the alveoli are filled with colloid which stains a bright red with eosin, and for the most part the acini are lined with a single layer of epithelial cells which are somewhat flattened in places.

There is no confluence of acini by destruction of the walls between neighboring alveoli. In certain areas small round cells are found in aggregation outside of the alveoli and in places cells of the same are found in considerable numbers within the acini. In brief, the thyroid changes appear to be those of a diffuse hypertrophy of the gland—colloid goiter.

The literature of chloroma is extensive, but the etiology of this rare lesion is unknown—even the cause of the green color of its tumor masses remains a mystery. General pathology has established the unquestionable relationship between acute leucemia and chloroma. Whether the hemic disorder and chloroma are one, or stand to one another as cause and effect, though most probable, cannot at present be claimed with certainty. Evidence in strong support of this statement and that the former starts up in the red bone marrow, simultaneous and multiple foci of origin, followed by an enormous increase of white cells, which have in addition acquired another inherent property or impulse, *i.e.*,

to multiply subsequently in the open blood and lymph-channels and particularly in the connective-tissue spaces throughout the body. In remote parts, such as the periosteum and dura of the skull, the sternum, the vertebral column, the subcapsular regions of the parenchyma of internal organs, as kidney and liver and subpleural regions of the lungs and the subpericardial ones of the heart, owing to tissue peculiarities, structural and territorial, this enormous massing of white cells leads to their arrest and subsequent incarceration in these remote localities, followed by the formation of countless foci or infiltrations which rapidly and inflexibly displace and compress the normal cell structures and sooner or later constitute the distinctive green tumor masses or chloromatous infiltrations.

An interesting fact is that the lymphatic glands, the lacrimals, parotids, and the spleen, do not participate in the same rapid manner, and that similar focal infiltrations do not take place, and that their induration is due to a diffuse or general overcrowding with white cells only.

These conclusions the autopsy of the present case and the microscopic examination of the pathologic specimens abundantly confirm, and principally that lungs, heart, liver, and kidneys under their serous envelops in remote or external parts of their parenchyma, and with the kidneys, on the part of their internal cavity or pelvis as well, had become the seat of countless pea-green infiltrations or tumor masses which projected only slightly over their unbroken surface, except when the protrusion or ectasia of the serous or capsular covering was so great that rupture had taken place and the greenish contents were discharged into the pleural, pericardial, or peritoneal cavities and, mixed with the fluid contents, changed the latter to a dirty gray or putty color.

In the pelvis of the right kidney this focal lymphocytic hyperplasiæ of its parenchyma had resulted in similar greenish projections, some of which had ruptured and filled the

pelvis with a dirty gray or greenish-gray looking mass. Another noteworthy point brought out was that, in spite of the numerous infiltrations, of which really only a smaller number were even visible at or near the surface of the pericardium and pleura, the capsule of the kidney, liver, and dura mater, the organs in question had sustained, comparatively speaking, little functional derangement until a later or more advanced stage was reached.

On the part of the brain this was particularly evident; the numerous pea-green, medallion-like, flat elevations of the dura had hardly or not at all indented, much less compressed, the brain at the points mentioned. Until a short time before he died his intellect and the other functions of his central nervous system remained unimpaired, and only when unmistakable sepsis, in consequence of pyonephrosis and similar but concealed foci of infection, had come about, were delirium and febrile disturbance added.

As to the periosteum, which resisted the almost phenomenal growth for a longer period and for evident anatomic reasons, after perforation in one or more places had once taken place, rapidity of growth was next to a visible fact.

Another interesting confirmation of known histologic facts was the scant vascularization of the tumor mass or, as better expressed, the neoplastic infiltrations, their firm, elastic consistency, the presence of only a most fragile connective-tissue framework, and the absence of even the most delicate envelop. On section, the masses looked like pale, juicy bacon. If the pericardium or pleura over the pea-green masses was stripped, it appeared to us that the greenish hue was intensified. It certainly faded after longer exposure to the air and changed to a dirty gray or putty color.

The early prominence and symmetric induration of the lacrimal and parotid glands, giving to the face and eyes, for a short time, the typical expression of Mikulicz disease, was dependent upon a steady growth of the subperiosteal tumor

masses in the apex and lateral walls of the orbit and face. These glands were not invaded, however, by focal or typical chloromatous infiltrations, but showed only an enormous diffuse hyperplasia of white cells. Later on, through compression, both lacrimal glands underwent atrophic changes and could not be differentiated from the tumor masses which completely filled both orbital cavities.

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DISCUSSION.

DR. ARTHUR J. BEDELL, Albany: Dr. C. S. Merrill and I reported a case of chloroma before the New York State Medical Society in 1907. The patient was an eight-year-old boy of foreign birth who died a short time after coming under observation. My second case was that of a female of twenty, also a foreigner. Her facial expression was the same as shown in Dr. Sattler's photographs. She was eight months pregnant, and died shortly after the first ocular symptoms.

Both of these cases were diagnosed before death, and elaborate studies were made as to the nature of the growth

and the derivation of the typical color. On autopsy the condition was confirmed.

The disease is so rare, and as the last case has not appeared in print, although in press, it seemed best to speak of them, especially as at the time of my first case 44 had been recorded and only four of them diagnosed before death.

DR. ROBERT SATTLER, Cincinnati: A full report of the chloroma case will shortly be published. Mainly for the reason that the present case afforded another instance in which the orbital cavities were early and dominant expressions of this rare lesion, I was prompted to offer this brief report. I have been much interested in Dr. Roy's remarks in discussing Dr. Week's paper. During recent years I have made a smaller number of osteoplastic or Krönlein operations. I have found that for tumors of the optic nerve in particular free and easy access for the purpose, first, of exploration and radical surgery as well can be secured by a method which I have resorted to in a number of cases belonging to this group.

I do not, like Dr. Roy, enter the orbit from above, but through a large incision at its external or temporal side. The lids are first securely united by three or even four strong sutures. A concentric marginal incision divides the tissues behind the conjunctival lining of the fornices and outer canthus, avoiding if possible disturbance of its continuity. The belly of the externus is sought and secured by a suture, divided, and permitted to retract. This affords undisturbed palpation of the walls and other structures, and makes possible a thorough exploration, and, if the tumor is not too large and further surgery is imperative, also its removal without bone surgery, thereby avoiding objectionable consequences and a more tedious recovery.

DR. DUNBAR ROY, Atlanta: I did not mean to give the impression that I go above the orbit, but those who have followed the Killian operation in making the incision will understand how readily you can pull the tissues back on the inner side in the region of the ethmoidal cells. If now you carry the incision around over the supraorbital notch to the external angle and pull the eyeball downward and outward, you obtain an excellent view of the orbital cavity.

THE TREATMENT OF TRACHOMA WITH RADIUM. THE USE OF RADIUM-COATED CELLULOID PLATES FOR THIS PURPOSE.

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The treatment of trachoma, even under the most favorable circumstances, is a tedious affair. On this account attempts are constantly made to discover some agent which will be an improvement over the long-established and generally used plan of treatment with sulphate of copper in those examples in which operation is not indicated—some local applications with which a cure can be effected in a shorter period and which will be free from pain and irritation. One of the most recent introductions for this purpose is radium. This agent has been found to possess properties similar to those of the *x*-ray, and soon after its discovery the effects upon trachoma were studied by ophthalmologists.

Previous to these therapeutic attempts the action of radium upon the eye was studied by Birch-Hirschfeld, Bock, and Selenkowsky. Birch-Hirshfeld,[2] in experimenting upon rabbits' eyes, found that strong doses and lengthy exposures were disastrous to the eye, causing inflammation of the conjunctiva and iris, opacities of the cornea and lens, severe inflammation of the skin of the lids with loss of lashes, and, in some cases, retinitis and atrophy of the optic nerve; the most pronounced changes took place in the epithelium and endothelium of the anterior portion of the eyeball, leading to total destruction of these layers. These observations led him to caution ophthalmologists against too prolonged and too strong exposures and to advocate the use of some

sort of protection to the eyeball when radium was used upon the lids. Bock[26] reported similar effects. Selenkowsky[21] studied the effects of radium upon normal eyes of rabbits and found that 30 mgm., applied directly to the eye for a period of half an hour to an hour, induced corneal opacity, exudate into the anterior chamber, hyperemia of the iris, and degeneration of the retina; 10 mgm. kept in front of the eye for longer periods also proved harmful; exposures for ten minutes every second or third day were not injurious, especially if the everted lids covered the eyeball.

Though the disastrous effects just mentioned were demonstrated upon the eyes of lower animals when exposed to large quantities of radium for long periods, smaller amounts and shorter exposures were found to be harmless as far as the eyeball was concerned, and yet sufficient to act favorably upon the course of trachoma. Some of the advocates of this form of treatment have, however, thought it wiser to protect the eyeball with a shield consisting of a prosthesis of glass rich in lead.

A number of observers have reported excellent results with this remedy; in some instances the trachoma follicles disappeared after a few exposures, and subsequent examination of the conjunctiva showed the absence of trachomatous tissue. Among those who have published favorable results are the following:

Williams[9] reported good results following exposures of two to three minutes with 50 mgm. of radium bromid, repeated once a week and later twice a week; the radium was held ½ cm. or less from the everted lid opposite the diseased area.

Cohn[15] used one mgm. of radium bromid enclosed in a small glass tube three cm. long and two mm. in diameter, touching every follicle of the upper and lower lids, treatments lasting ten minutes daily; the follicles disappeared in a surprisingly short time in contrast to the behavior of similar cases which had been treated for months with painful remedies.

Falta[19] published his experiences with two cases of severe trachoma and one of follicular conjunctivitis treated by massaging the infiltrated conjunctiva with a rounded glass tube containing one mgm. of radium bromid; the first case was exposed for a total of one hundred and sixty-two minutes, the second seventy-eight minutes, and the third twenty-four minutes; the result was a disappearance of the granules and absorption of the trachomatous infiltration; two of the cases were complicated with pannus and this also was favorably affected.

Beck[23] reported three cases (one of subacute trachoma, a second of trachoma with pannus, and a third of acute trachoma) completely cured (the acute case almost cured) as a result of the use of radium; he advised using not less than 50 mgm. of radium bromid of 10,000 radio-activity; the glass tube was placed in contact with the tissues for from ten to thirty minutes at each sitting, which was repeated daily or less often; he noted severe reactions but never burns, and thought the former due to mechanical irritation rather than to the action of the radium.

Selenkowsky[22] treated 25 cases of trachoma with very good results; incidentally he confirmed Darier's findings that radium has a quieting effect upon pain. He used 10 mgm. of radium bromid and exposures of from five to ten minutes; he cautioned against exposing the globe directly to the agent; he claimed that all of the 25 cases were thoroughly cured except four, that 14 of these were observed for a long time and remained cured, and that no scars resulted.

Thielemann[29] reported six cases of undoubted trachoma treated in Kuhnt's clinic; two mgm. of radium bromid were used in a glass tube, exposures varied from five to ten minutes, and the eyeball was protected by a prosthesis of glass containing a very high percentage of lead; one eye of each patient was treated, the other eye being used as a control—the lids everted and their granules subjected to

identical conditions of pressure, air, and light. He found that the granules exposed to radium commenced to disappear after seven or eight days, while they were not completely removed from the plica semilunaris as late as the forty-sixth day; the epithelium remained intact and there was no discharge of gelatinous granulation substance. Microscopic examination of pieces of conjunctiva excised from the lids which had been treated with radium showed great difference as compared to specimens of conjunctiva from lids which had not been treated. In the former there were no signs of typical granules; only the inclosing membrane was left, almost without cells, looking like an emptied nest; the blood-vessels appeared to be more numerous and of larger lumen, and near the dissolved or shrunken granulations they seemed to be filled with polynuclear leucocytes. This observer refrained from optimistic conclusions fearing these might be premature, emphasized that his object was to prove the undeniable influence of radium upon granulosis, and expected to report later whether a definite cure or only a transient effect had been obtained.

Kardo-Sisoyeff,[38] employing a glass tube containing 10 mgm. of radium, with weekly exposures of three to ten minutes' duration, observed rapid disappearance of the follicles, diminution in the infiltration, favorable action upon pannus, but no effect upon cicatricial tissue; anatomically, he found a marked reduction of lymphocytes in exposed parts of the conjunctiva.

Darier[24] and Thiebault[31] have taken rank with the enthusiastic advocates of the radium treatment of trachoma.

On the other hand, there have been reports on the effects of radium in trachoma which have not been favorable. Thus Jacoby,[41] working in Uhthoff's clinic in Berlin, published the results of the treatment of 11 cases of trachoma with radium, and his conclusions were as follows: 1. Radium seems to exert a certain influence on trachoma. 2. It has not yet

been determined how far this may be favored by other factors of treatment (radium massage, hyperemia). 3. The results of radium applications are inferior to those obtained from mechanical and medicamentous treatment as to safety and durability. 4. The universal employment of radium may cause a loss of valuable time in the case of progressive processes.

Birch-Hirschfeld[27] has contributed an article dealing with clinical and anatomic investigations of the action of radium on trachomatous conjunctivitis. After treating 10 cases of undoubted trachoma with 10 mgm. of radium bromid by means of exposures of from three to twenty minutes, he found marked flattening and disappearance of the follicles; in one case this effect lasted several weeks; but in the other nine patients new follicles developed after days and weeks, even on the very spots which had received direct exposures to radium. Thus, radium treatment revealed no advantages over other methods (roller forceps, massage, silver salts, cuprocitrol salve); and after the use of this remedy for months the affection required treatment in other ways. This investigator reported that after exposures to radium, the trachoma follicles presented the same anatomic structure as was found by Heinecke in normal lymph-follicles; he stated that the trachomatous conjunctiva reacted very readily to radium, but that the benefit was only of temporary duration and that no permanent cures ensued, since there was evidence that after the discontinuance of the exposures to radium new formations of follicles took place; he also warned against the employment of too strong a preparation and too long or too frequent sittings.

Harman (quoted by Marple[35]) treated two patients having trachoma with radium without benefit, though in one 37 and in the other 139 exposures were made.

It is significant that, notwithstanding the favorable experiences recorded above, nothing further has been reported

during the last year or two, and it is equally certain that radium is not being used to any extent in the treatment of trachoma. Independent of the question of the efficiency of this remedy, there are a number of reasons which would operate against its popularity: First, radium is exceedingly expensive, representing a considerable sum of money, and independent of cost is not always procurable; second, it is somewhat risky to allow so costly a remedy to be handled by others; third, the great expense would prevent any number of tubes of radium from being available, and since exposures are of five to ten minutes' duration, a very limited number of patients could be treated in this manner; finally, a certain amount of protection to the eyeball seems desirable. For these reasons the treatment could never become universal nor popular.

Desiring to test the value of radium in trachoma in a form which would obviate the objections just alluded to and permit the remedy to be used in a practically available manner, I made use of a radium bromid coating upon celluloid plates. Through the courtesy of Mr. Hugo Lieber, the principal importer of this substance, a quantity of radium bromid was placed at my disposal. Celluloid plates were coated on one side with a film of radium bromid. having a radio-activity of 25,000, protected by a layer of water-proof varnish; the plates were shaped like the solid blade of an entropion forceps, so that the broad or coated end could be readily applied to the trachomatous surface of either the upper or lower lid, and the celluloid itself would act as a protection to the eyeball. Each plate required about $35 worth of radium bromid. The method of application was the following: After or without previous local anesthesia, the broad radium-coated end of the instrument was inserted beneath the upper lid of one eye, the radium coating pressed against the granulations, the patient then holding the plate in position; at the end of ten minutes

the plate was transferred to the lower lid, with the radium coating next to the granulations; thus the treatment consumed twenty minutes for each eye. Possessing four of these plates, several patients could be treated simultaneously. The radium treatment was applied to the right eye in each instance and, by way of control, the left eye was treated in the usual manner with sulphate of copper. The plates always gave rise to discomfort, even when the eye had previously been anesthetized, causing irritation, lacrimation, and sometimes pain. This may have been due to the mechanical effect of the plate pushed between the lid and the eyeball.

Fifteen patients were treated in this manner. Four were old cases of trachoma with beginning cicatricial changes, without pannus; four represented the cicatricial stage in great part, with more or less pannus; two were of the large frog-spawn variety, which the late Herman Knapp described as non-inflammatory; three were examples of ordinary trachoma of moderate severity with no cicatricial development, and two represented the so-called mild trachoma type, in which there was room for difference of opinion as to whether they were real trachoma or merely catarrhal conjunctivitis with follicular enlargement. The following are brief histories of each of these cases:

I. Male, forty, Italian. Well-marked trachoma both eyes; duration unknown. Right eye treated with radium, ten minute exposures three times a week, continued for three months (40 treatments). The left eye, similarly affected, treated with sulphate of copper. At the end of three months the left eye had improved considerably more than the right. Three months later, no treatment having been applied in the interval, both objective and subjective symptoms of the right eye had increased; in the left eye the improvement brought about by the three months' course of bluestone treatment was maintained.

II. Male, twenty-six, Hungarian. Well-marked tra-

choma just beginning to show cicatricial changes, but no pannus. Right eye treated with radium, ten minutes three times a week, left eye with sulphate of copper three times a week. At the end of six weeks the patient refused to allow a continuation of radium treatment, though he was willing to continue with the bluestone. At that time no change in objective and subjective symptoms of right eye was apparent, while the left eye showed some improvement. This patient disappeared, but was traced one year later; he had been operated upon (expression) elsewhere; he still had trachoma, though less marked than when I stopped treatment.

IV. Male, forty-three, Austrian. Well-marked trachoma of limited duration, with large granulations; little cicatricial tissue. This patient received 40 exposures to radium for the right eye and 40 treatments with copper for the left eye, applications three times a week. Although a local anesthetic was used preliminary to each application, the immediate effect of each radium treatment was to cause a great deal of irritation, and the patient complained greatly of the pain; he tolerated the bluestone applications to the left eye much better. At the end of three months there was some improvement in the right eye, but considerably more in the left. At the end of six months, treatment having been discontinued for three months, the condition resembled that originally observed, and the lids were operated upon.

V. An eight-year-old child of Bohemian parents. Both eyes presented well-marked trachoma in the cicatricial stage, with islets of granulations and with fairly marked pannus. The right eye was treated with radium three times a week for six weeks, the left eye with bluestone applied with equal frequency. At the end of three months there was no change in the pannus on the right side, while on the left there was appreciable improvement and vision had risen from $\frac{20}{100}$ to $\frac{20}{50}$. Treatments were discontinued. A year later both eyes were operated upon elsewhere.

VI. Male, fifty-six, Italian. Old trachoma advancing toward the cicatricial stage. Treatment as in Case V. The patient disappeared from observation after six weeks' treatment, during which time neither eye had been appreci-

ably benefited. I traced him eighteen months later and found his eyes in the same condition as when originally examined.

VII. Female, thirty-three, Italian. Lids in same condition as Case VI. Treated four months with marked improvement in left eye (treated with sulphate of copper), and less improvement in the right eye, which had been exposed to radium.

VIII. Male, twenty-four, Hungarian. Old trachoma changing to cicatricial stage, with well-marked pannus. Treated with radium for right eye and sulphate of copper for left. At the end of two months the patient refused additional treatment, claiming that the reaction and discomfort interfered with his work. There had been little improvement in either eye. He disappeared and could not be traced.

IX. Boy, eight, German parentage. Well-marked trachoma of the frog-spawn, non-inflammatory type. Treated three months, radium right, bluestone left. Neither remedy made much impression on the size of the granulations. After watching for subsequent effects and finding none, I operated upon both eyes with the roller forceps.

X. Boy, nine, Irish parentage. History identical with that of Case IX.

XI. Boy, twelve years old, American parentage. Granulations of moderate size. Treatment continued for five months, radium to the right eye and bluestone to the left. At the end of this period there was slight improvement on the right side and very marked improvement (conjunctiva almost smooth) on the left side. After waiting three months the condition remained the same. Then bluestone was applied to both sides; three months later the lids of the left eye were practically cured; those of the right eye were improved, but not cured.

XII. Boy, ten, American parentage, a cousin of Case XI, lived in the same house, and history is identical with the preceding report.

XIII. Girl, six, Russian parentage. Trachoma of moderate degree of severity. After three months' treatment with radium for the right eye and bluestone for the left there was some improvement on the left side and very little

on the right. The patient discontinued treatment and disappeared. I traced her a year later through hospital records, and found she had been operated upon (expression).

XIV and XV. Both occurred in children, and represented that type of conjunctivitis which is conveniently spoken of as "mild trachoma," and in which it is a question whether the disease is really an example of trachoma or merely an instance of chronic conjunctivitis with follicular enlargement of both upper and lower conjunctivæ. These patients were treated in the same manner as others: radium for the right eye and bluestone for the left. At the end of three months in one, and at the end of two months in the other, the left eye was cured, but the right eye still presented evidences of follicular enlargement though less than when treatment was begun.

SUMMARY: (1) In most of the cases (7) the treatment was continued three months; in one case, four months; in two cases, five months; in three cases, six weeks; in two cases, two months. The radio-activity was 25,000, the exposures were repeated every two or three days and lasted ten minutes for the upper lid and ten minutes for the lower lid. Some of the cases were observed for long periods after discontinuing the treatments.

(2) In no case was the result of the treatment with radium as good as obtained with sulphate of copper. Radium exercised a favorable influence upon the condition, but the left eyes treated with sulphate of copper improved more rapidly than the right eyes which were exposed to radium. In every instance the patient complained more of the irritation of the radium plates than of the bluestone.

(3) Used in the form of radium-coated celluloid plates, the results obtained in the treatment of trachoma did not warrant the adoption of this remedy in place of other means which are more or less satisfactory. It may be argued that had the radium been used in more concentrated form in glass tubes, the results might have been better and more in

conformity with the reports of those investigators who have been favorably impressed with the action of this remedy; but, as explained above, there are a great many difficulties associated with the use of radium in concentrated form in glass tubes. When these drawbacks were removed by using coated plates, the results were less satisfactory than those obtained with the stick of sulphate of copper.

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DISCUSSION.

DR. R. A. REEVE, Toronto: I may say I have had radium, 5 mgm., for a good while and treated other affections of the eye pretty satisfactorily with it, but have not used it in trachoma, not thinking that I was justified under the circumstances in treating these cases with radium bromid.

RECURRENT RETINAL HEMORRHAGES OCCURRING IN THE YOUNG, WITH THE REPORT OF A CASE.

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In reporting the following case of recurrent retinal hemorrhage in a young man, aged twenty-two years, it is with the hope of contributing something toward clearing up the etiology of this extremely rare and little understood disease of adolescence. In the present case not only were there repeated and extensive hemorrhages, but a most pronounced perivasculitis, especially affecting the veins, followed in each eye by proliferating retinitis, vascular veils,

and vitreous opacities, with almost total loss of vision of the right eye, and vision reduced to $\frac{2}{40}$ in the left.*

Family History.—Father living, about fifty-five years old, and in fairly good health. As a young man was delicate and was sent to the Adirondack Mountains on two occasions for some months. Is of slender build, troubled with indigestion, and has a high arterial pressure, 170 to 200.

Mother living, about fifty years of age, and in robust health. Has two sisters, one robust, but the other is of slender type like the father, and troubled with indigestion.

Personal History.—Male, aged twenty-two years; when a child had measles, scarlet fever, and diphtheria, but no serious complications or after-effects. Has always been troubled more or less with indigestion, but not seriously, and Dr. Burke, the family physician, tells me he was not constipated. The patient is slender, but well muscled, height about 5 feet $10\frac{1}{2}$ inches, weight about 145 pounds. He is of very florid complexion, resembling his mother in this respect, rather nervous, and inclined to worry, though as a rule is cheerful. The patient objected to a college course, but as his parents were anxious for him to have a college degree, he had been at Princeton for three years. He worried a great deal over his studies and examinations, and the worry and anxiety may have been partly responsible for his nervous indigestion. In the last four months the patient has lost flesh, and his father noticed he was not looking well. Has played golf a great deal and has driven an automobile considerably, and at high speed. There is no history of syphilis, acquired or inherited, and Wassermann is negative. A thorough physical examination by Dr. Burke proved negative so far as any body lesion was concerned; and Dr. Janeway, who later saw the patient in consultation, confirmed this finding. Examination of the urine on November 9th revealed nothing abnormal save indican "strongly increased." I may say the patient's urine had been examined by Dr. Burke two or three times a year for many years, and at no time had there ever been any indication of kidney lesion. The blood examination was normal in every respect and the blood-pressure 120.

*June 30, 1912, detachment of the retina occurred in left eye, reducing vision to counting fingers at ten feet.

Ocular History.—Until two weeks before coming under my observation (November 6, 1911) the patient had never had any trouble with his eyes, and had always possessed very acute vision. Two weeks ago he noticed some red specks in front of the right eye and a few days later red specks in front of the left eye, with slight inflammation or rather irritation of the eyeballs. He paid little attention to it, as he had no pain in the eyes, and the vision remained good. His father, who happened to be visiting him at college, noticing that his son did not look very well, had him consult his family physician, Dr. Martin Burke, who fortunately understood thoroughly the use of the ophthalmoscope, examined him, discovered something radically wrong in the fundus of each eye, and referred him to me.

Eye Examination.—Vision, R. E. = $\frac{20}{20}$ −, increased to $\frac{20}{15}$ with + .50 s. + .50 c. 90; L. E. = $\frac{20}{15}$, increased to $\frac{20}{15}$ + with + .50 s.

Ophthalmoscopic findings are as follows: *Right Eye.*—A large subhyaloid hemorrhage extends across the lower part of the fundus from side to side, about one disc width below the disc. The lower part of this hemorrhage is deeply serrated, is broader at the nasal extremity, and grows narrower as it extends toward the temporal side. There is another small hemorrhage (half size disc) just below and to the nasal side of disc, and a third (about the same size) just above the disc, and several "drops of blood" came forward into the vitreous from this last hemorrhage. All of the veins of the fundus are surrounded by dense, broad, white bands, twice the width of the veins themselves, extending from the disc to the extreme periphery. The same white bands surround the arteries, but to a lesser extent. Later in the disease, areas of white exudates and sheet-like hemorrhages were present.

Left Eye.—There are two small hemorrhages, one in the inferior nasal quadrant, the other in the superior temporal quadrant, each apparently from a vein. The veins and

arteries in the left eye are surrounded by broad white bands just as in the right, but not quite to the same extent. The disc in each eye appears a little "fuzzy." Tension normal in each.

There is an irregular scotoma in the upper half of the right field of vision, and the patient complains of seeing red in the right eye when he looks above or directly ahead. November 9, 1911, there occurred a very extensive hemorrhage into the right eye, filling the upper, outer, and central parts of the vitreous. Great splotches of blood could be seen in the vitreous and the outlines of the fundus were obliterated except at the lower inner quadrant.

The left eye showed numerous small hemorrhages along the veins and some areas of white exudate both in the upper and lower parts of the fundus, between the branches of the veins. The vitreous was a little hazy and outlines of the disc fuzzy. V. O. D. = $\frac{20}{100}+$; O. S. = $\frac{20}{20}$.

November 19, 1911, the hemorrhage in the right eye had cleared greatly and some fresh spots of white exudate could be seen in both the upper and temporal and inferotemporal side of the fundus. There were also some fine new blood-vessels coming forward into the vitreous, far up and temporally, seen best with +6 D.

Dr. de Schweinitz, who saw the patient in consultation on this date (Nov. 19th), remarked the great likeness of this case to the one he had reported to the American Ophthalmological Society in 1907. The similarity was so marked as to be almost startling, he said, when he first looked into the eye. And the drawing he had made of the fundus of the right eye of his case might well be taken as a correct representation of the fundus of the right eye of this case on Nov. 19, 1911.

On Nov. 20th the patient was sent to the hospital and put to bed. As the temperature was normal, the tuberculin test was made; .2 mgm. T. O. was given. A rather severe

reaction followed. That night the temperature rose to 102° F. Patient vomited several times, and later complained of chilliness and severe pain in the back and in the legs. On the second day temperature came to normal. The local effect on the eyes was a marked flushing of the sclera in each eye, but fortunately there were no fresh hemorrhages into the vitreous. Atropin and dionin were ordered locally, and very hot saline solutions were applied to the eyes on pledgets of cotton for twenty minutes at a time four times a day, which were very soothing. Later iced applications were used. He was given a pilocarpin sweat twice a week, followed by an alcohol rub. The bowels were kept open and the diet regulated, but not greatly restricted, as the patient's temperature dropped to 97° or 97.6° (rectal) every evening. Hydriodic acid in one dram doses was given three times a day, and a small amount of pepsin after each meal, as the patient complained of wind on the stomach and some indigestion.

December 9th: The vitreous hemorrhage in the right eye continued to clear, though there were more new-formed blood-vessels in the vitreous. Left eye, the perivasculitis continued to increase and a few small hemorrhages occurred in the upper part of the fundus. The haziness of the vitreous increased gradually. As a therapeutic measure, .1 mgm. T. O. was given. In three hours the temperature dropped to 97° F., by rectum (the temperature was taken by rectum at all times), and in ten hours had risen to 102.2°. Patient was slightly nauseated and had headache. Three hours later the temperature was 98.9°, and a feeling of malaise, pain in the back, and loss of appetite were present.

December 10th: The day following the injection there was an extensive hemorrhage into the vitreous of the left eye, the vitreous was quite hazy, but the upper part of the fundus could be seen, and the perivascular changes surrounding the retinal vessels continued to increase. In the right

eye a small hemorrhage occurred into the vitreous just above the macular region.

A word in reference to the condition of the kidneys is necessary here. The urine, which at first had an excess of indican, had, under regulation of the diet and free drinking of water, been entirely normal until Dec. 8th. No albumen, no sugar, no indican, no casts, and a daily amount of 50 to 60 ounces. On this date (Dec. 8th, one day before the second injection of .1 mgm. T. O. was given) the urinary examination showed "many hyaline and granular casts," but there was no albumen or indican, and specific gravity was 1018. The patient was restricted to milk and cereal diet.

December 11th: Urine showed trace of albumen, "great excess" of indican, and casts were very numerous, large and small hyaline, finely and coarsely granular, epitheliated and mixed (granula, red cells, epithelia, and leucocytes).

December 18th: Albumen, a trace; indican, normal; casts, "innumerable, large, coarsely granular and finely granular, occasional epithelial and mixed." Undoubtedly there was a "desquamatous involvement" of the kidneys present.

December 26th: Urinary examination was entirely normal.

On January 12, 1912, urinary examination was normal, save for two or three hyaline casts, and a few hyaline casts were present in the urine until Feb. 14, 1912. Since then none have been found, and only occasionally has there been an excess of indican, which later was promptly eliminated by regulation and restriction of the diet.

The blood-tests, I may say, remained normal in every respect throughout his illness. The coagulation time was slightly increased.

On December 13, 1911, Dr. Wilmer, of Washington, saw the patient in consultation, and advised extreme quiet in bed and the administration of calcium lactate and the

application of leeches to the temple. One leech was applied to the left temple, but the patient had a horror of leeches, and so strenuously objected to them that no more were applied. Calcium lactate in 5 to 10 grain doses was given, but was discontinued, as it seemed to upset the patient's stomach, and adrenalin chlorid, 15 minim doses three times a day, was given. Later in the treatment calcium lactate was given again in larger doses, but finally abandoned.

December 16th: The last pilocarpin sweat was given. The temperature kept so low every evening, 97° to 97.6° F., that it was thought best to discontinue same. The patient was kept extremely quiet in bed, but this procedure seemed to have little influence on the hemorrhages, because on Dec. 17th there was an extensive hemorrhage in the left eye from the superior nasal vein on the edge of the disc, pushing up the retina on the nasal side +4 D. There was a hemorrhage also extending to the temporal side almost to the macula, but not quite reaching it, elevation of the retina +3 D. Directly above the macula, about one disc width from it, was a fresh arterial hemorrhage, which had broken into the vitreous. The vision was greatly reduced, counting fingers at three feet with difficulty. Right eye, slight arterial hemorrhage above the disc. Because of the continued hemorrhages, injections of human serum were advised, but this the parents refused to have done.

December 23d: Dr. Janeway saw the patient in consultation and pronounced him physically sound. He advised more freedom for the patient, and, if possible, that he be sent South to be in the open air with moderate exercise.

December 24th: There was a slight redness of the whole lower half of the right sclera; also a slight hemorrhage in the lower part of the fundus.

December 30th: Patient greatly disturbed by indigestion. Following a violent sneeze, the patient had a fresh hemorrhage into the left eye, reducing the vision in that eye still fur-

ther, just to counting fingers. On this date I gave $\frac{1}{1000000}$ mgm. "B. E." (Mulford). That is, I reduced the 2 min. of the No. 1 vial 100 times, and gave 2 min. of this dilution. This dose was doubled each day. The third dose, 8 min. = $\frac{1}{250000}$ mgm., gave a distinct focal reaction in each eye; that is, the lower half of each sclera was distinctly flushed two hours after the injection. No general reaction.

A new dilution of 2 min. of No. 1 "B. E." (Mulford) was made by reducing it 10 times; and 2 min. of this was given = $\frac{1}{100000}$ mgm., then 4, 8, respectively, on succeeding days till $\frac{1}{25000}$ mgm. was given. These injections caused no general reaction, but each day the sclera in the lower half of each eye would inflame two hours after the injection. To control this a weak solution of cocain was dropped into the eye, and a little white vaselin applied. The No. 1 vial "B. E." mixture of Mulford was now used, beginning with 2 min. and giving the injections twice a week, increasing 2 min. a dose until 20 were given at once. Then vial No. 2 was used, beginning with 2 min. and increasing two at a dose until 20 was reached. Then vial No. 3 was used, beginning with 2 min., and increased to 4 min. (Jan. 26, 1912), which was the largest dose the patient would tolerate, equaling $\frac{1}{50}$ mgm.

Some general reaction was obtained, and the sclera of the eyes became quite red after the injections. We then dropped back to 4 min. of No. 1 "B. E.," and held the patient at that, twice a week, until April 1st. Although the patient's general condition improved, the hemorrhages continued in the left eye until Jan. 18, 1912, when the last extensive hemorrhage occurred, making four large hemorrhages that had taken place in that eye. Four small hemorrhages (seeping) also occurred on Feb. 4, 7, 11, and 24. In the right eye only two large hemorrhages occurred, but the second one, Nov. 9, 1911, was so extensive that it did irreparable injury to the eye. Only a few small seeping hemorrhages followed in this eye, the last one on Feb. 11,

1912. It is significant that no further bleeding took place in either eye after the patient went into the country on Long Island.

On January 11, 1912, the hemorrhages not abating, the parents consented to have some blood-serum injected. Dr. John E. Welch, of New York, collected the serum and made the injections: Jan. 13, 1912, 16 c.c.; Jan. 14, 1912, 18 c.c.; Jan. 16, 1912, 20 c.c.; Jan. 17, 1912, 22 c.c.

This series of injections seemed not to have much effect on the hemorrhages, since on Jan. 18th an extensive hemorrhage occurred in the left eye.

February 2, 1912: Small hemorrhages continuing in the left, a second series of injections of human serum was begun: Feb. 2, 1912, 20 c.c.; Feb. 3, 1912, 18 c.c.; Feb. 4, 1912, 30 c.c.

February 4, 1912, a small hemorrhage in the left eye.

February 9, 1912: The third and last injections of human serum were begun: Feb. 9, 1912, 30 c.c.; Feb. 10, 1912, 11 c.c.

Although the patient had considerable human serum injected, it had little effect in checking the hemorrhages. However, Dr. Welch was of the opinion that the patient did not have nearly enough of the serum injected to be effective. No untoward symptoms followed the injection of the serum, and there was no indication whatever of "serum fever."

On February 22d a slight eruption occurred in the axilla of the left arm, but this quickly subsided. Again on March 20th the patient had a small boil in the left axilla.

On February 24, 1912, the patient was sent to the south shore of Long Island, so that he could be in the open, where he remained until April 5th. No hemorrhages occurred in either eye while he was there and the improvement in vision in the left eye in the last two weeks of his stay was remarkable, increasing from counting fingers at 4 feet to $\frac{20}{200}+$. The vision in the right eye, $\frac{20}{200}$, remained unchanged. The patient gained in flesh, and cheerfulness

returned with the cessation of hemorrhages and returning vision. The fundus examination at this time revealed the following condition: Right eye, a large, dense, white mass of connective tissue extending from the disc outward, over and beyond the macula. Springing from this mass above were numerous vascular membranes extending forward into the vitreous. These membranes were evident in all portions of the eye except the inferior nasal quadrant. There were numerous punctate opacities in the vitreous.

Left eye, detachment of the retina, by exudate underlying it, extended from the disc nasally to the periphery of the fundus, seen best with +6 D. Another area of detached retina extended up and temporally above the macula, and a third downward and temporally below the macula, both seen with +6 D. Fortunately the macula itself seemed to hold in position, although above, below, and to the temporal side of the macula signs of retinitis proliferans were only too plain, vascular veils coming forward into the vitreous, and numerous punctate opacities filled the vitreous—a most unpromising outlook!

The patient was now sent south to Washington, D. C. (April 7, 1912), where Dr. Wilmer kindly took him under his skilful care. Here but little medication was given, the patient spending a great deal of his time in the open air driving. Locally, alternating cold and hot applications were made for five minutes at a time twice a day; an ointment, equal parts of ung. hydrarg. and sapo virid., a piece the size of a small pea, was rubbed on the temples (alternating) once a day. One saline injection under the conjunctiva R. E., was given, which caused considerable reaction, but seemed to improve the vision in that eye only slightly. Two injections of tuberculin, each $\frac{1}{5000}$ mgm., were given, but caused no reaction of any kind.

Dr. Morgan, at Dr. Wilmer's request, placed the patient on a diet while there, and administered small doses of tincture

of iodin, acid. phenolis, and bismuth subnit. One severe attack of indigestion with vomiting occurred while in Washington, with loss of two or three pounds in weight. However, the patient returned to New York, May 9th, in good spirits and feeling very happy. V. O. D. = $\frac{4}{200}$; O. S. = $\frac{20}{40}$ +*

The vitreous opacities had cleared to a great extent, especially in the left eye, and the exudate underlying and pushing up the retina (which obtained when he left New York) had almost completely absorbed. Unfortunately, at the site of these exudates vascular membranes had sprung forth into the vitreous, seen best with a + 6 to + 15 D., and while the vision is now very good ($\frac{20}{40}$), we still have the danger of the increasing retinitis proliferans. The immediate macular region is still comparatively free from membranes.

The patient is now in the Adirondacks living in the open, and practically taking no treatment, except observing general hygienic rules. A quotation from a letter received June 11, 1912, will explain his condition and how he feels.

"We have at last taken up our residence in camp and I am growing healthy by the minute, and feel sure that by the end of the summer I will be a new man, physically, as well as having my eyes much improved.

"The camp is situated on a bluff overlooking the lake and surrounded on all sides by tall pine trees. I live in the open the entire day, coming in only for meals, which I eat with the greatest appetite. Two helpings by all means, say I. Stomach in fine shape and no indigestion at all. You see from this report that I am still able to sit up and take notice. My eyes are about the same, as far as I can judge, but if anything a little clearer."

Remarks: The salient features of this case may be summarized as follows:

* Dr. Morgan examined the feces of the patient while he was in Washington with a negative result so far as any special organism was concerned as a possible cause of the recurrent retinal hemorrhages.

(1) The decided diagnostic reaction of the old tuberculin in very small doses on two different tests, and the equally positive therapeutic reaction to the new tuberculin, especially the flushing of the sclera following these injections, signify beyond question that tuberculosis was an etiologic factor.

(2) The history of repeated attacks of indigestion before the present trouble, one so severe as to resemble an attack of appendicitis; and the numerous attacks of indigestion during the present illness, together with the presence of an excess of indican in the urine at the very outset of his hemorrhages, and the acute desquamatous involvement of the kidneys in the early part of his present trouble, make it equally certain, also, that auto-intoxication was a factor in the etiology.

(3) Worry and anxiety over his studies at college may have played a minor rôle as a cause.

(4) Syphilis may be excluded.

(5) This is the first time, so far as I know, that human serum has been injected to prevent the recurrence of hemorrhages into the retina; in this instance it seemed to have little or no influence in checking them. But Dr. Welch thinks the patient did not have sufficient quantity of the serum injected; so the test cannot be regarded as final.

(6) Absolute rest in bed, or moderate exercise, neither appeared to bear any relation to the frequency of recurrence of hemorrhages into the retina in this case. If the patient is being sweated, or if the bleeding is extensive, he should be kept in bed for a few days at a time; otherwise the course to pursue in handling such cases is moderate exercise in the open air.

(7) Perivasculitis was a most pronounced feature of this case, together with the retinitis proliferans, showing a diseased condition of the retinal vessels, more marked in the veins. This decided perivasculitis obtains most often in

cases due to syphilis, but in the present case we are safe in excluding syphilis.

(8) The hemorrhages seemed to come from the retinal veins and arteries, and not from the choroidal veins as seen by other observers (Zieminski).

(9) The patient's blood-pressure and blood-tests were normal throughout.

(10) All treatment seemed of little avail in checking the hemorrhages, though I am inclined to give the tuberculin injections, the open-air treatment, and the general hygienic management of the case the chief credit in securing so good a result thus far obtained.

In looking over the literature of the subject one is struck, first, by the rarity of such cases; second, by the uncertainty as to the cause of the trouble; and, third, by the variety of remedies and procedures recommended for the cure of the disease—a sure sign that there is no effective remedy.

As to the *etiology*, here are a few of the causes mentioned: Tuberculosis (Axenfeld); auto-intoxication; syphilis; inequalities of the blood-pressure, either too high or too low (Hutchinson, Krauss); decreased coagulability of the blood; increased coagulability of the blood (Collins and Mayou); malignant endocarditis (Grimsdale); hemophilia (Noll); suboxidation (Ziegler); nasopharynx and accessory sinus disease (de Schweinitz); constipation (Eales); malarial fever (Kries); vicarious menstruation in females; establishment of the sexual function in the male.

As to the various *remedies* and *procedures* mentioned for the cure and prevention of this disease, I append a partial list: Nitroglycerin; ergot; calcium lactate; adrenalin chlorid; gallic acid and numerous other hemostatics; iodin in its various forms; mercury in its various forms; dionin; thyroid extract (Ziegler); thyroidin; fibrolysin; sajodin; substituting isotonic saline solution, 85%, for the diseased vitreous, about 5 c.c. Elschnig has reported one case of

vitreous hemorrhage treated in this way, where all other treatment had failed to give relief, and the result was highly gratifying, improving vision from just perceiving movements of the hand to .8 normal!

Galvanic electricity, the negative pole over the lids and the positive pole to the nape of the neck, has been highly recommended. Nelson M. Black reports a case treated in this manner, and cites another case of intra-ocular hemorrhage treated by Coleman (Wood's Therapeutics) with only light perception, unimproved by three months' previous treatment, which recovered normal vision in nine months, and with no recurrence of hemorrhage in three and one-half years.

Ligature of the common carotid artery has been recommended and practised by Mayweg as a last resort. In Mayweg's case the left eye was lost by hemorrhage into the vitreous, followed by detachment of the retina. In order to save the right eye, which also became affected, he resorted to the above desperate measure, and was rewarded by stopping the progress of the disease.

Krauss, in a most excellent review of this subject of recurrent retinal hemorrhages in the young, with the report of a successfully treated case, sums up the treatment of such cases in the following words:

"Treatment must be more or less empirical and guarded by common sense. Generally speaking, it should consist of absolute rest, attention to the general health of the patient, and the treatment of the local eye condition."

Retinitis proliferans, which frequently accompanies and follows recurrent retinal hemorrhages, is a most serious complication and often results in detachment of the retina. A comprehensive article on this subject was published by Dr. J. E. Weeks,* with the report of four cases, two of which came to section, together with a résumé of the cases re-

* Trans. American Ophth. Soc., 1897, p. 158.

ported to that date. A brief résumé is also given in Weeks' Text-Book of Diseases of the Eye, page 458, in which he emphasizes the fact that "the formation of the membranous structures is always preceded by the presence of a fibrous coagulum, with or without blood-corpuscles, extending into the vitreous and resting at some point on the retina due to leakage from retinal vessels."

The other serious complications which may follow recurrent retinal hemorrhages are: Secondary glaucoma; softening of the eyeball with atrophic changes—either of which is usually fatal to the sight.

So little can be done to check recurrent retinal hemorrhages in the young that we have reason to be profoundly thankful that the disease is such an extremely rare one.

DISCUSSION.

DR. M. L. FOSTER, New Rochelle: I wish to call attention to one clinical symptom of the juvenile hemorrhage into the vitreous which the writer, although he has referred to it, did not bring out very strongly, and that is the rapidity with which they are absorbed in comparison with hemorrhages into the vitreous produced by any other cause whatsoever. I have seen only a very few cases. One was that of a young man, about twenty-one years old, who had a hemorrhage that covered the macula, which disappeared completely, as I remember it, inside of three weeks. Now we know that hemorrhage from traumatism or from any other disease takes a good deal longer than that to clear up. Every case that I remember reading about, although my memory may be faulty in this respect, has been a subhyaloid hemorrhage that lay more or less in front of the macula. Dr. Davis remarked the presence of flame-like hemorrhages in the retina. I would like to know whether these flame-like hemorrhages into the retina were absorbed as rapidly as the hemorrhages that were subhyaloid, because it is my impression that true retinal hemorrhages were not present in the cases that I have seen or in those that I have happened to read about; but this does not prove that they are necessarily

absent. The presence of casts and albumen in the urine suggests the possibility that this was a mixed case; that is, a case of juvenile hemorrhages into the vitreous associated with hemorrhages into the retina from a retinitis, perhaps albuminuric, and it seems to me that the combination of these two conditions would be extremely difficult to differentiate. I would like to ask Dr. Davis if he can tell me whether the hemorrhages in the retina were absorbed with the same rapidity as those in the vitreous? I think that his answer might furnish a diagnostic point as to whether the case was really a mixed one or an unusual one of pure juvenile hemorrhage.

DR. ROBERT SATTLER, Cincinnati: These cases are certainly of great interest to us all, and have called forth such a full discussion that I will only refer to them from the viewpoint of prognosis. In spite of an almost endless and tedious course with indifferent or unsatisfactory results from medicinal and other measures, recovery nevertheless occurs in many cases, with restoration of useful vision, even though it may have been seriously disturbed or lost for a longer period. I have under observation, for more than fourteen months, a young man of twenty-four. Both eyes are affected. Hemorrhages and exudates have been so marked and excessive that, at different periods lasting weeks, vision was reduced to light perception. He has had recurrent subhyaloid, intrahyaloid, and fundus or retinal hemorrhages and massive organized vitreous opacities besides. At present, after months, vision has again risen so that he is able to go about. Dr. Risley, in a previous discussion, referred to a plan of treatment suggested by Dr. Martin Fischer, of Cincinnati, for edema or acidosis of the tissues. This method was faithfully tried in this case, but we were convinced that the subconjunctival injections of both the weaker and stronger solutions of citrate of soda were attended only by indifferent or negative returns, and that the final betterment could, with greater fairness, be attributed to the use of ergot and bromin and the many other measures resorted to in the course of the long and varied therapy. The merciful feature of these cases is that, after an almost interminable period, recovery comes about, often with preservation of useful vision, which, in view of the enormity of the path-

ologic changes enacted, hardly appears a possible inference during the early stages.

DR. WILLIAM H. WILMER, Washington: I was fortunate enough to see this patient. These cases are very interesting from several points of view; first, the economic, because they usually occur in the young male; second, the pathetic, for sometimes both eyes are involved; and, third, the obscurity of the etiology and pathology. As the eye is a very vascular organ, its health depends a great deal upon the condition of the blood-stream. This stream is not only a nutrient one, but it is also a sewer, carrying off the products of waste and altered secretions from distant organs. We know from experiments upon the lower animals that terror causes an altered glandular secretion. This effect passes off shortly. However, we cannot say how long or how serious in the human being are the effects of various psychic states, especially in the young. I think the careful and critical examination of the blood will aid in the discovery of the cause of these cases. We can also gain some knowledge from the examination of the sound eye.

In not all of these cases are both eyes affected. The fundus of the better eye usually shows a striated appearance of the retina from edema, with darkness of the venous current (sometimes with white reflex from the vessel). This striation suggests an infiltration of the fluid portion of the blood into the retinal tissue. In regard to treatment, I think we have some absolute indications. With a broken vessel, it is rational to put the patient quietly in bed, which lowers the arterial pressure upon the weakened vessels and gives a chance for more rapid healing. One would not expect to find increased blood-pressure in these youthful cases. I have not, in my experience, found it increased in any of these cases. My experience does not agree with the suggestions made by Collins and Mayou that increased coagulability of the blood is a possible cause of these hemorrhages. In all of my cases the coagulation time has been either slightly or greatly delayed. When this condition exists, it can be met by careful administration of lactate of calcium. This has to be given carefully on account of the possibility of increasing the plasticity also of the extravasated blood, which would interfere with the speedy absorption.

In these cases, in my experience, there are always symptoms at least of suboxidation and often of constipation. In some of them there has been positive tubercular reaction, in others, negative; in some there has been marked pyorrhœa alveolaris, so we have here some definite things to guide us in the treatment. We can put the patient to bed, we can give appropriate treatment for any of the previously mentioned conditions, and later we can use subconjunctival injections of normal salt solution. This has been valuable in my personal experience. It aids absorption and reduces the acidity of the tissues. By occasionally giving the lactate of calcium, while using the injections of salt, we need not run the risk of decreasing the coagulability of the blood.

DR. JOHN E. WEEKS, New York: These cases of hemorrhage in adolescence are extremely interesting. I do not think that they all belong to the same category. The case reported by Dr. Davis undoubtedly presented a condition in which the coats of the arteries were weakened, possibly throughout the system, by some toxic influence. He gives a picture of a leakage from the vessels into the perivascular spaces occurring in the vessels of the retina and a history of parenchymatous nephritis. A toxemia is apparent; the origin of the toxemia is obscure. There is an acknowledged cause of toxic conditions which produces hemorrhages that has not been mentioned, and that is the presence of certain parasites in the intestinal tract. Intestinal parasites should be searched for in every obscure case. The feces should be examined carefully. The indications for treatment are the elimination of the toxemia. Tuberculosis should never, in my opinion, be ignored. I do not think that the examination of the blood in this case was thorough enough. We find a condition of hemophilia present in not a few of the cases. Examinations of the blood should be most complete and should be made frequently. I do not think that local treatment in these cases has much, if any, effect. Subconjunctival injections have been worthless in hemorrhages of the retina. Too much importance has been attached to the results of subconjunctival injections, of whatever kind. We must reach these cases through the system by the use of remedies which will change the conditions—eliminate the toxemia and strengthen the walls of the blood-vessels, so as to prevent the leakage which takes place.

In regard to the development of retinitis proliferans: In this case of Dr. Davis' it must have begun long before he saw the patient, since it takes time for retinitis proliferans to develop. The development of retinitis proliferans is preceded by the formation of a clot in the vitreous body from whatever source. It may be due to tuberculosis, to traumatism, or to syphilis. Given a favorable condition of the system for development of a pseudomembrane, all of these conditions, by first producing a clot in the vitreous body, may develop a retinitis proliferans.

DR. S. LEWIS ZIEGLER, Philadelphia: It seems to me that this case is not a typical example of hemorrhages occurring in the young, as described by Eales of Birmingham, whose cases were associated chiefly with constipation. He explained this through splanchnic spasm and reflex disturbance of the retinal vessels. I think that there are many causes for these cases. I recall a case that I reported about twenty years ago which followed a long siege of dysentery. The hemorrhages extended over a period of eight or ten years, and were followed by blindness and recovery of vision after cataract extraction. The majority of cases, however, seem to be the result of metabolic disturbances following respiratory obstruction and lowered oxidation. Now as to the question of treatment. Following the suggestion recently made as to the treatment of uterine hemorrhage by hypodermic injections of ampules of pituitary extract, I have had very good success in one case with that treatment. To absorb the hemorrhage I think that there is no remedy comparable with extract of thyroid, given in small doses. You can accomplish more with that in a few weeks than you can in months by any other treatment, with one exception, and that is galvanism. Judging from the reports of various observers, you can use either positive or negative galvanism. I have always used the positive. I have previously placed on record a case in which the hemorrhage was retained in the eye for about eighteen months. The vision was reduced to $\frac{8}{200}$, and recovered to about $\frac{20}{30}$ and J. 1 after an extended course of galvanism. I do not think it makes any difference whether the positive or negative pole is used—the influence is entirely that of electrolysis. In other words, the clot is broken up and later absorbed.

DR. HIRAM WOODS, Baltimore: I want to call attention to a study of this affection presented at the Los Angeles meeting of the American Medical Association in June, 1911. I collected all the cases I could. Incidentally I reported six that had come under my own observation. First, as regards the affection of one or both eyes. I think Dr. Wilmer is right in saying that if you get a hemorrhage in one eye and study carefully the well eye, you are very apt to find some of the edematous symptoms he mentions. In other words, you have something wrong with the vascular structure of both eyes. The work of de Schweinitz and others in reference to the eye being in a general way an "eliminative organ" is also of great importance. Now, as to the extent to which we can give any remedy the credit for cure. All cases are not like Dr. Davis', where there were recurrent hemorrhages. That does occur in a good many. In others there is one single hemorrhage. If that hemorrhage occurs in the vitreous, it will probably clear up and normal vision be re-established. The same is true of subhyaloid hemorrhage. On the other hand, the hemorrhages go on one after the other for a certain time and then something seems to stop them. We do not know what this is. There is no treatment that is always followed by cessation of hemorrhage. Sometimes it stops without treatment. I do not believe Dr. Wilmer would attribute the cure of this man, after all he has been through, solely to the remedies used when he came under his care in Washington. The case is typical—repeated hemorrhages and then an unexplained stop. Improved nutrition and rest have, probably, most to do with cure, if such a term is applicable. I do not believe there is any one remedy that can be relied on. In many of the cases reported to me a year ago definite evidence of intestinal toxemia was present. I recall one where helminthiasis was at the bottom of the toxemia, and the patient seemed to get better after the parasite had been expelled. The general results of all the cases I was able to secure were that recurrent hemorrhages were very apt to end in retinitis proliferans. A number of them developed chronic glaucoma. Dr. Weeks sent me a case of a girl of sixteen years who had lost both eyes from chronic glaucoma. One eye was removed because of severe pain. As a rule, the

vitreous hemorrhage absorbs more rapidly than the subhyaloid, with restoration of vision and a normal fundus. I think we cannot now go much further than to say that such cases present evidence of a toxemia which for some reason is affecting either the choroidal or retinal blood-vessels, and that every case is a difficult clinical study in itself.

DR. SAMUEL D. RISLEY, Philadelphia: The remark which just has been made by Dr. Weeks in reference to the importance of studying the bacteriology of the intestinal tract finds analogy in the well-known cases of recurrent hemorrhages with proliferating retinitis associated with disease of the general vascular tree in syphilis. If Metchnikoff is correct in his belief that not only are certain toxins and the products of fermentation and putrefaction absorbed from the intestinal tract and prove harmful to the organism, but that the micro-organisms composing the intestinal flora are also absorbed, finding their entrance, like syphilis, through the doorway of the epithelium, and may be carried by the blood-stream to any of the tissues, where would these micro-organisms find a more likely nidus than in the choroid and retina? I have under my care at the present time a patient, thirty-five years of age, the victim of virulent syphilitic infection, who affords a striking illustration of the subject under discussion. He has had these recurrent hemorrhages again and again in spite of antisyphilitic treatment.

DR. A. EDWARD DAVIS, New York: In reply to the question as to the rapidity of absorption of the hemorrhages, I may say that, with the exception of the first hemorrhage in the right eye, which was subhyaloid and took a long time, the other hemorrhages were rapidly absorbed. My patient furnishes strictly a typical case of the kind under discussion. Dr. Burke had him under observation since a small child, and made frequent examinations of the urine. The father, who had been rather delicate himself, had looked after the boy in the most anxious manner, and had the urine examined two or three times a year, and, until this illness, the patient had never had any abnormality of the urine except some slight excess of indican. Therefore, I do not think the case can be considered anything like one of ordinary albuminuric retinitis.

As to the presence of the retinitis proliferans, this did

not appear until some weeks after the patient came under observation, and showed first in the right eye. Undoubtedly this boy had this inflammation of the retina some time before he came under my care.

The surprising thing to me in the case was the acuity of vision, with the blood-vessels so extensively involved. During the course of the disease the right eye had two rather large hemorrhages, and then they ceased. The left eye had six large and many small ones, recurring at varying intervals. No treatment was of avail to check them, and the case is plainly a typical one of recurrent retinal hemorrhages of adolescence.

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1900	*Dr. C. D. Wescott,	22 E. Washington Street,	Chicago, Ill.
1891	Dr. Edward Wheelock,	26 Gibbs Street,	Rochester, N. Y.
1892	Dr. J. A. White,	200 E. Franklin Street,	Richmond, Va.
1895	Dr. W. H. Wilder,	1417 Peoples Gas Bldg.,	Chicago, Ill.
1910	*Dr. Carl Williams,	School L. & Greene St.,	Philadelphia, Pa.
1874	Dr. Chas. H. Williams,	1069 Boylston Street,	Boston, Mass.
1912	*Dr. Edw. R. Williams,	1069 Boylston Street,	Boston, Mass.
1893	Dr. Wm. H. Wilmer,	1610 I Street, N. W.,	Washington, D. C.
1888	Dr. F. M. Wilson,	834 Myrtle Avenue,	Bridgeport, Conn.
1906	Dr. J. Scott Wood,	172 Sixth Avenue,	Brooklyn, N. Y.
1898	*Dr. William L. Wood,	412 Oregonian Bldg.,	Portland, Oregon.
1900	Dr. Hiram Woods,	842 Park Avenue,	Baltimore, Md.
1881	Dr. J. P. Worrell,	20 South 7th Street,	Terre Haute, Ind.
1905	Dr. Wm. Zentmayer,	1819 Spruce Street,	Philadelphia, Pa.
1903	Dr. S. Lewis Ziegler,	1625 Walnut Street,	Philadelphia, Pa.
	Total		198

HONORARY MEMBERS.

1866	Dr. Jno. Green,	Metropolitan Bldg.,	St. Louis, Mo.
O.M.	Dr. B. Joy Jeffries,	15 Chestnut Street,	Boston, Mass.
1868	Dr. J. S. Prout,	Garden City,	Long Island, N. Y.
O.M.	Dr. F. P. Sprague,	229 Commonw'lth Ave.,	Boston, Mass.
	Whole number		202

MINUTES OF THE PROCEEDINGS.

FORTY-NINTH ANNUAL MEETING.

THE NEW WILLARD,

Washington, D. C., May 6, 1913.

The Forty-ninth Annual Meeting of the Society was called to order at 9.15 A. M. by the President, Dr. Myles Standish.

THE PRESIDENT: I wish to thank the Society for the very great honor conferred upon me by my election to this position. It is an honor which I highly appreciate. It is fortunate for me and doubly fortunate for you that this Society does not expect a presidential address, but there is one subject which I wish to bring to your attention, hoping that there may be some consideration of it at this meeting, and that is the question, which is appearing in many forms, of a degree in ophthalmology. If we are to have a Doctorate of Ophthalmology granted by various colleges and universities, it is sure to be a very diverse sort of degree. Every individual institution, every individual professor, perhaps, will have a different standard, with the result that a degree will be granted which will be comparable to the old fashioned M.D., in that it will stand for divers efficient and inefficient kinds of preparation, and if this Society is to exercise any influence upon that degree, now, before it becomes established, is the time. It seems to me a proper thing for this Society, in executive meeting today, to take some measures to consider whether such a degree is desirable. If so, what time should be devoted to acquiring it, what should be taught, and what the standards of graduation should be.

The President announced the appointment of the following Committee:

On Time and Place of Meeting.—DRS. SAMUEL THEOBALD, ARNOLD KNAPP, and W. H. WILDER.

The following papers were read and discussed:

1. "Degeneration of the Corneas of a Man and His Adult Son," Dr. Burton Chance.

Discussed by Drs. Zentmayer, Weeks, de Schweinitz, Theobald, and Chance.

2. "An Extreme Case of Conical Cornea with Cataract," Dr. David Harrower.

3. "Keratoconus, with Reports of Cases," Dr. John E. Weeks.

Papers of Drs. Harrower and Weeks discussed by Drs. Jackson, Sattler, Beard, Wilmer, Wilder, Sutphen, Posey, Greenwood, Zentmayer, Lancaster, Harrower, and Weeks.

4. "Interstitial Keratitis of Luetic Origin," Drs. George S. Derby and Clifford B. Walker (by invitation).

Discussed by Drs. Gruening, Bruns, Marple, Parker, Randolph, Beard, de Schweinitz, Kollock, Weeks, Callan, Ziegler, Sattler, Harlan, Lambert, Alling, and Derby.

5. "Ophthalmia Artefacta (?)," Dr. Henry Dickson Bruns.

Discussed by Drs. Verhoeff and Bruns.

6. "The Prophylaxis of Ocular Birth Infections," Dr. Robert Sattler.

Discussed by Drs. Howe, Holt, Fiske, and Sattler.

7. "An Unusual Case of Staphylococcus Conjunctivitis," Drs. William H. Wilder and David J. Davis (by invitation).

Discussed by Drs. Verhoeff, Howe, Davis, and Wilder.

8. "A Case of Congenital Apron of the Palpebral Conjunctiva," Dr. Henry H. Tyson.

9. "Report of a Case of Bilateral Congenital Ptosis Relieved by the Motais Operation," Dr. B. R. Kennon.

Discussed by Drs. Holt, Jackson, Kollock, Bruns, and Kennon.

The President announced that the following were invited to sit with the Society and take part in its discussions: Drs. Hunter H. McGuire, D. J. Davis, Clifford B. Walker, Casey Wood, Frank Allport, H. Bert Ellis, Mary Buchanan, and J. O. MacReynolds.

AFTERNOON SESSION, MAY 6TH.

10. "Discission of the Crystalline Lens," Dr. Edward Jackson.

Discussed by Drs. Sattler, Ziegler, Jack, and Jackson.

11. "Two Cases of Simple Chronic Glaucoma Treated by Iridotasis," Dr. David Harrower.

Discussed by Drs. Gruening, Ziegler, Marple, Risley, Theobald, Jackson, Randall, and Harrower.

12. "Fourth Series of Cases of Injuries from Foreign Bodies Examined by the Roentgen Rays, with Results of Operation," Dr. William M. Sweet.

Discussion was postponed until the reading of Dr. Sherman's paper.

EXECUTIVE SESSION.

TUESDAY AFTERNOON, MAY 6TH:

The President, Dr. Myles Standish, called the meeting to order at 5 P. M.

Dr. Jackson moved that the reading of the Minutes be dispensed with. Carried.

The following committees were announced:

On Membership for Next Year—DRS. PETER A. CALLAN, HIRAM WOODS, W. H. WILMER, RICHARD A. REEVE, and ALEXANDER QUACKENBOSS.

On Bulletin—DRS. G. E. DE SCHWEINITZ, W. T. SHOEMAKER, and WILLIAM M. SWEET.

Auditing Committee—DR. W. B. MARPLE.

Publication Committee—Drs. Wm. Zentmayer, W. E. Lambert, and William M. Sweet.

The Treasurer's report was read, and, the Auditing Committee having certified to its correctness, it was accepted and placed on file.

On motion of the Secretary it was voted that the assessment for the current year be five dollars.

The Committee on Wood Alcohol Blindness had no report to make, and asked to be discharged. Carried.

The Committee on Membership recommended the following-named candidates for admission to the Society, and they were declared elected as Associate Members:

Dr. F. D. Bailey, Brooklyn, N. Y.

Dr. Robert S. Lamb, Washington, D. C.

Dr. Lee Masten Francis, Buffalo, N. Y.

Dr. Chas. R. Heed, Philadelphia.

Dr. C. E. G. Shannon, Philadelphia.

Dr. A. L. Macleish, Los Angeles, Cal.

Dr. H. G. Goldberg, Philadelphia.

The Committee also referred the names of other candidates to the Committee for 1914.

Dr. Theobald inquired whether the Committee thought of increasing the somewhat limited membership of 200.

Dr. de Schweinitz said that the Committee had considered briefly the advisability, or rather the inadvisability, of increasing the membership of the American Ophthalmological Society, and had reached the conclusion that it would be most inadvisable to increase our membership.

The Committee presented the following nominations of officers of the Society for the ensuing year:

President: Dr. Robert Sattler, Cincinnati, O.

Vice-President: Dr. M. H. Post, St. Louis, Mo.

Secretary and Treasurer: Dr. William M. Sweet, Philadelphia.

Corresponding Secretary: Dr. Arnold Knapp, New York.

It was moved that the Secretary be authorized to cast a ballot for the election of the officers as nominated by the Committee, which motion was carried, and the officers were declared elected.

Dr. de Schweinitz, on behalf of the Committee on Membership, made the following motion, which was carried:

> That a Committee be appointed consisting of five members, one of these members to be the present Presiding Officer of the American Ophthalmological Society, which Committee shall take into consideration all matters pertaining to the standards which should be required for the degree of Doctor of Ophthalmology by those universities which have this subject in contemplation, or which have already established courses in ophthalmic science, with a view to the issuance of such a diploma.

This motion was made because of the opening address of the President.

Dr. de Schweinitz made the following statement: The Membership Committee, whose spokesman has himself no motion to make, hopes that some member of the Society will introduce a resolution which shall contain instructions with reference to the admission of members into our Society. It has seemed to the Committee on Membership that during the last few years not infrequently difficulty arises in regard to what action the Committee shall take with reference to certain candidates, not because these candidates are ethically ineligible, not because they are not excellent citizens in their own community, but because they seem to be lacking in scientific requirements. In other words, they have not yet won their spurs—have not yet demonstrated their fitness for the honor of membership in this Society. It has seemed to the members of the Committee that some more definite rule should be made than now exists with reference to the standards of admission to this Society; it has seemed to them, in short, that the standard is now lower than it ought to be.

This Society is recognized as the representative gathering of ophthalmologists in the United States and Canada, and the Committee hopes that it may continue to hold this position, but it has very distinct rivals in the field, and it is desirable that we shall not permit men to enter our Association until they have given definite evidence that they intend to conform with and maintain the standards according to which this Society has always conducted its affairs. As one member said today, "recognition by the American Ophthalmological Society is a stamp of approval," and this stamp of approval should not be given, as it has, in the opinion of the Committee, only too frequently in the last few years, unless the candidate has demonstrated his fitness to have this stamp placed upon him.

Dr. Weeks moved that a committee of three be appointed to take the matter under consideration, and that the committee report at the next meeting.

Dr. de Schweinitz suggested that the subject might well go to the committee which is to be appointed to consider the question of post-graduate education in ophthalmology. Carried.

Dr. Sweet suggested that a committee be appointed to rearrange the constitution and by-laws of the Society, and, if possible, send out before the next meeting a printed sheet of such changes as are thought advisable, so that the members can come to the meeting prepared to act on them.

Dr. Weeks said that, as this subject is germane to the subject for which the committee is to be appointed to determine the matters relating to a diploma in ophthalmology, it seemed to him that it might be wise to refer this matter to that committee, with the idea of having a report at our next meeting. Carried.

Dr. Howe said he ventured to bring up a subject bearing on the question of membership. According to our present usage, a man is allowed to be absent if he gives a valid ex-

cuse. That word valid has been understood to mean that he need only say that he cannot come. As our membership list is now practically full, it would seem advisable to facilitate the methods for eliminating the names of those who do not attend, and who are not exempted by the by-laws, so that their places can be taken by good men who would bring life and strength to our organization. Dr. Howe offered the following motion:

> That it is the sense of the Society that the Secretary shall understand that an excuse for absence is valid only when a member is absent from the country or ill, or when there is illness of a member of his family.

Dr. Risley said that, if the motion offered by Dr. Howe should prevail, the Secretary could have printed on the call for future meetings this resolution in addition to the by-law which has always been published. Dr. Howe's motion was then carried.

Dr. Howe presented the following motion:

> That, when the Secretary sends out the names of applicants for membership, there shall be stated after each name the original work which has been done by the applicant, the titles of the papers he has prepared, and the publications in which they may be found.

This motion was amended, providing that the subject be referred to the Committee to be appointed to consider the standards of admission to the Society. Dr. Howe accepted the amendment, which was carried.

Dr. Theobald, chairman of the Committee on Time and Place of Meeting, made the following statement:

The Committee has an alternative report to make. There have been two suggestions that have favorably impressed the Committee, one that the Society meet next December at the holiday season, during the vacation of the colleges, in the city of New York. The merit of this suggestion seemed

to be that the members of the Society would be enabled to attend interesting and instructive clinics at the larger ophthalmic hospitals of the city. The other suggestion is that the Society meet, in May next, at Hot Springs, in Virginia. The reason why May is suggested rather than the usual time of meeting (July) is because it is thought many of our members will, in July, be on their way to the International Congress of Ophthalmology at St. Petersburg. The objection to having it in June is that it would very nearly correspond in time with the meeting of the American Medical Association. These two plans are put forward, and we think it would be well for the members to consider the matter until tomorrow, when the question can be decided by vote of the Society. The advantages of Hot Springs are that it is a delightful place in the early summer; that the proposed time of meeting is between the winter and summer seasons, so that the hotel will be less crowded, and for this reason it is not improbable some reduction in the usual rates may be accorded the members in attendance; and that we shall all be together in one large hotel, well appointed in every way.

Dr. Sweet stated that the Committee, appointed two years ago to prepare additional copies of the card containing the smallest reading print of the set recommended several years ago by a committee of the Society, had to report that the matter was turned over to Dr. Charles H. Williams, who had charge of the preparation of the old cards, and that he had new cards made, on one margin of which the old nomenclature of the type was placed and on the other margin the new nomenclature. Dr. Sweet said that there were on hand sufficient copies of the old sets to supply a copy to each member, together with the new sets, and suggested that these be sent to members without cost.

Dr. Weeks made a motion to this effect, which was carried.

Dr. Edward Reynolds, representing the American Gyne-

cological Society, upon invitation, addressed the meeting upon the importance of the formation of a national organization for the recognition and treatment of cancer, and offered the following motion:

> That a Committee of the American Ophthalmological Society be appointed, to meet similar committees to be appointed by other societies composing the Congress, for the purpose of forming a national organization for the education and publicity work in the recognition and treatment of cancer, and that the several committees meet as soon after the adjournment of the Congress as possible.

Dr. Howe moved that the President be authorized to appoint the Committee. Carried.

The President announced the appointment of the following committees:

Committee on Post-graduate Education in Ophthalmology.—Drs. G. E. de Schweinitz, Edward Jackson, John E. Weeks, S. D. Risley, and Myles Standish.

Committee to Form a National Organization for the Study of Cancer.—Drs. R. A. Reeve, F. E. Cheney, and Hiram Woods.

The Secretary read a communication from Dr. W. W. Keen in reference to the proposed memorials to commemorate the great services of the late Lord Lister, and asked that the Society make an appropriation from its treasury to the fund to be raised for this purpose. A letter was also read from Dr. Harry Friedenwald, asking that a contribution be made by the Society to a fund to be used to present an artistic medal to Dr. Julius Hirschberg on his seventieth birthday.

Dr. Jackson moved that these communications be filed, and the gentlemen from whom they had been received informed that it has not been the custom of this Society to

contribute for such undertakings, but that the attention of members had been called to the invitation to contribute.

The Secretary read a communication from the Panama-Pacific Commission, inviting the Society to hold its meeting in California in 1915.

Dr. Jackson said that, on a former occasion, an invitation was extended to this Society to hold a meeting in Colorado, and it is our desire to renew the invitation. In order that the matter may be carefully considered he presented the following motion:

> That the Secretary be instructed, previous to the next annual meeting, to take a postal card vote of the membership of the Society on the question of holding the 1915 meeting of this Society in Colorado.

Dr. Jackson said that there were reasons that will appear pro and con that it is not necessary to go into now. Of a number of advantages, he thought the one most worth considering above all others was that it would give the American Ophthalmological Society a broader view of the field that it undertakes to occupy and that we want to see it occupy among the professional organizations of this country. So long as our Society is local in its meetings, and to a considerable extent in its membership, it will not be representative of the whole of this country. That will be understood better by some of our members if they do what is proposed—what the invitation offers. It will be done some time, he had not the slightest doubt. It should be done as soon as the members want to take the time to attend a meeting farther away.

Dr. Derby alluded to the fact that the American Medical Association would meet in California in 1915.

Dr. Jackson said that he thought that all the reasons for going to California could be urged for going to some place in that direction which is nearer. We can secure a place where a meeting can be held much more satisfac-

torily if we avoid such a large gathering as there will be in San Francisco that year.

Dr. Jackson's motion was carried.

Dr. de Schweinitz alluded to a letter received from Dr. B. Joy Jeffries, of Boston, in which he pointed out his very considerable service to the Society in years past, and his desire that his name should be placed on the Honorary Membership list.

It was moved and carried unanimously that Dr. Jeffries be placed on the list of honorary members.

A communication was read from the Fourth International Congress of School Hygiene, which will meet at Buffalo, N. Y., August 25–30, 1913, asking that delegates be appointed to represent this Society at the Congress.

Dr. Howe moved that favorable action be taken on the communication, and that three delegates be appointed by the Chair. Inasmuch as the question of vision is important, he thought it would be wise for the Society to be represented. Carried.

The President appointed Drs. S. D. Risley, Lucien Howe, and H. G. Sherman as delegates to the Congress.

The Executive Session then adjourned.

MORNING SESSION, MAY 7TH.

Exhibition of Cases and New Instruments and Apparatus.

Dr. Robert L. Randolph exhibited two cases:

1. A further study in the history of a subretinal mass.
2. The remains of sympathetic ophthalmia.

Dr. G. S. Crampton exhibited a case of double coloboma of the optic nerve.

Discussion by Drs. Weeks, Jackson, and Crampton.

Dr. S. Lewis Ziegler showed a new operating lamp of the Nernst pattern.

Dr. W. B. Lancaster demonstrated a new transilluminator.

Dr. J. H. Claiborne showed a new lens for aphakia.

Dr. David Harrower presented a new electric attachment for the ophthalmoscope.

Dr. S. D. Risley exhibited the drawings of a modified typewriter table, to be used as an ophthalmic treatment cabinet, designed by Dr. J. N. Risley.

Dr. Charles H. May presented the model of an ophthalmoscope which could be used either as an ordinary reflecting or as a self-luminous electric instrument. The mirror was interchangeable.

Dr. F. H. Verhoeff showed some simple attachments for electric hand-lamps. He also demonstrated the filamentous organism, recently found by him in eleven out of twelve cases of Parinaud's conjunctivitis, which he believes is undoubtedly the cause of the disease.

Discussion of instruments and apparatus by Drs. Marple and Snell.

The reading of papers was resumed.

13. "A Contribution to the History of the Magnet as Applied to Ophthalmic Surgery," Dr. H. G. Sherman.

Papers of Drs. Sweet and Sherman discussed by Drs. S. D. Risley, Holt, Gruening, Jackson, Marple, Weeks, Lambert, Ziegler, Maxson, Callan, Sweet, and Sherman.

14. "The Experimental Production of Sclerokeratitis and Chronic Intra-ocular Tuberculosis," Dr. F. H. Verhoeff.

15. "On Some Forms of Retinal Tuberculosis," Dr. Arnold Knapp.

Discussed by Dr. Derby.

16. "Two Unusual Orbital Conditions," Dr. Wm. Campbell Posey.

Discussed by Dr. Jackson.

17. "Report of a Case of Cavernous Sinus Thrombosis Resulting from a Small Abscess in the Skin of Temple—Vaccine Treatment," Dr. Albert C. Snell.

Discussed by Drs. Gruening, Jackson, Jack, Weeks, Verhoeff, Sattler, and Snell.

EXECUTIVE SESSION.

WEDNESDAY MORNING, MAY 7TH.

The President called the meeting to order at 11.30 A. M.

The Report of the Committee on Time and Place of Meeting was taken up.

Dr. Jackson moved that the meeting be held at Hot Springs, Va., in May, the exact date to be fixed by the Committee and Secretary.

Seconded and carried.

The Committee decided to hold the next annual meeting on Tuesday and Wednesday, May 12 and 13, 1914, at The Homestead Hotel, Hot Springs, Va.

The Secretary read proposals for membership. These were referred to the Membership Committee for next year.

Executive Session adjourned.

The scientific meeting was immediately resumed.

18. "Sarcoma of the Choroid, not Demonstrable by the Ordinary Transilluminator," Dr. Allen Greenwood.

Discussed by Drs. Gruening, Fridenberg, Marple, Randolph, and Greenwood.

19. "Epibulbar Carcinoma, with Histological Examination of the Specimen," Drs. G. E. de Schweinitz and E. A. Shumway.

Discussed by Drs. Gruening and de Schweinitz.

20. "Toxic Amblyopia due to Tobacco Alone," Dr. Matthias Lanckton Foster.

Discussed by Drs. Gruening, Theobald, and de Schweinitz.

AFTERNOON SESSION, MAY 7TH.

The reading of papers was resumed.

21. "A Case of Paralysis of Divergence," Dr. William Zentmayer.

22. "Some Striking Examples of Subnormal Accommodative Power," Dr. Samuel Theobald. Read by title.

23. "The Eye Examination a Help to Diagnosis of Commencing Arteriosclerosis," Dr. Edward R. Williams.

Discussed by Drs. Mittendorf, Zentmayer, Greenwood, and Williams.

24. "A Case of Thrombosis of the Retinal Vein, with Remarks," Dr. J. Herbert Claiborne.

Discussed by Drs. Greenwood, Snell, and Zentmayer.

25. "Teaching Physiological Optics," Dr. Walter B. Lancaster.

Discussed by Drs. Jackson, Randall, and Lancaster.

26. "One Word More on Test-cards and Type," Dr. B. Alexander Randall.

Discussed by Drs. Zentmayer and Randall.

27. "Fatigue of Convergence and its Varieties," Dr. Lucien Howe.

The President announced that 98 members had registered at the meeting.

Adjourned.

Members present at the Forty-ninth Annual Meeting:

ADAMS, JOHN L.
ALLING, A. N.
BEARD, CHAS. H.
BEDELL, ARTHUR J.
BROWN, E. V. L.
BRUNER, WM. EVANS
BRUNS, H. DICKSON
BUTLER, W. K.
CALLAN, PETER A.
CARMALT, W. H.
CARPENTER, JOHN T.
CARROLL, JAMES J.
CHANCE, BURTON
CHANDLER, H. B.
CLAIBORNE, J. H.
CLAP, EDMUND W.

CRAMPTON, GEORGE S.
DERBY, GEORGE S.
DODD, OSCAR
ELLETT, E. C.
FENTON, THOMAS H.
FISKE, GEORGE F.
FOSTER, MATTHIAS L.
FOX, WILLIAM H.
FRIDENBERG, PERCY
GREENE, LOUIS B.
GREENWOOD, ALLEN
GRUENING, E.
HANSELL, HOWARD F.
HARLAN, HERBERT
HARROWER, DAVID
HARVEY, N. D.
HOLLOWAY, T. B.
HOLMES, C. R.
HOLT, E. E.
HOWE, LUCIEN
HUNTER, D. W.
JACK, EDWIN E.
JACKSON, EDWARD
KENNON, B. R.
KNAPP, ARNOLD
KOLLOCK, CHARLES W.
LAMBERT, WALTER E.
LANCASTER, WALTER B.
LANGDON, H. MAXWELL
LESTER, JOHN C.
LORING, FRANCIS B.
LORING, ROBERT G.
LOVELL, D. B.
MARPLE, W. B.
MAXSON, S. C.
MAY, CHARLES H.
MCINTOSH, J. R.
MILES, HENRY S.
MITTENDORF, W. F.
PARKER, WALTER R.
POSEY, WM. CAMPBELL
PRICE, HENRY R.
PUSEY, BROWN
RANDALL, B. ALEX.
RANDOLPH, R. L.
RAY, J. M.
REEVE, RICHARD A.
REYNOLDS, W. G.
RICHEY, S. O.
RING, HENRY W.
RISLEY, SAMUEL D.
ROY, DUNBAR
SATTLER, ROBERT
SAUTTER, ALBERT C.
SCHNEIDEMAN, T. B.
DE SCHWEINITZ, G. E.
SHANNON, JOHN R.
SHERMAN, H. G.
SHOEMAKER, W. T.
SMITH, E. TERRY
SNELL, ALBERT C.
SPALDING, F. M.
SPRATT, CHARLES N.
STANDISH, MYLES
SUTPHEN, T. Y.
SWEET, WM. M.
TAYLOR, LEWIS H.
THEOBALD, SAMUEL
THOMSON, EDGAR S.
THORINGTON, JAMES
TYSON, HENRY H.
VERHOEFF, F. H.
WAITE, FRANK L.
WEEKS, JOHN E.
WHITE, J. A.
WILDER, WM. H.
WILLIAMS, EDWARD R.
WILMER, W. H.
WOOD, J. SCOTT
WOODS, HIRAM
ZENTMAYER, W.
ZIEGLER, S. LEWIS

DEGENERATION OF THE CORNEAS OF A MAN AND HIS ADULT SON.

BURTON CHANCE, M.D.,
Philadelphia.

Notwithstanding the fact that numerous cases of nodular degeneration of the cornea, as found directly connected in two or more generations or in several members of a family, have been reported in the past twenty years, such occurrences are by no means as common as one might be led to believe from a review of the literature; and, although at the meeting of this Society last year Dr. Dunbar Roy detailed six cases in a single family, I now venture to report the finding of the affection in a man and his son, because I believe their disease presents certain characteristics unlike any other heretofore described.

The men were referred to me by Dr. Frederick Willson, of Reading, Pa., in November, 1912. They had become well known in their community as self-supporting blind men; the father maintaining traveling "Punch and Judy" and other penny shows at fairs, and the son keeping a small shop and pool room.

The father is fifty-four years of age, a native of Pennsylvania, of German descent, born of unrelated parents. In his early manhood he assisted his father in the tuning and repairing of pipe-organs; the building of organs had been conducted by five generations of his family. In none of his progenitors was there one known to have been affected by any unusual trouble with the sight. He gives no history of serious bodily illness nor of accidents, but his eye-sight has always been poor. In infancy and early childhood he had severe attacks of "sore eyes," but he doubts that the inflammation either caused his bad sight or appre-

FATHER'S CASE

R

L

SON'S CASE

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L

Cases of Degeneration of Corneas in a Man and Son. After drawings by Miss Washington.

ciably diminished what he had. In the summer of 1912 he had an attack of the same kind of inflammation, which did not materially affect what sight he had left.

The man is well developed, is of quite heavy build, though but of about five feet six inches in height. He is of an amiable disposition and of distinct intelligence. He was married at twenty-four; has had three children, one dying in infancy; a daughter, whose eyes are healthy, and the son, the subject of the accompanying history, remaining.

He has had only the most irregular kind of attention given to his eyes. He states that several physicians to whom he applied for treatment suggested that his disease had been caused by inherited specific infection, and they prescribed mercury without paying any attention as to the effects of that drug, and he drifted away.

The visual acuity in recent years has been equal to only the appreciation of the motion of fingers at a foot or two. When the eyes are at rest, they deviate in the direction of the axes of the orbits in the manner of amaurotic eyes; but all attentive-ocular movements are preserved, and the irides react. The conjunctivas in the lower folds are somewhat thickened, as though there had been repeated attacks of conjunctivitis, which probably was the disease mentioned. The upper tarsal surfaces are smooth and healthy. The globes are well formed, and show no signs of serious disease, past or present, other than what is here specified in the description of the corneas.

At the center of each cornea, and for two-thirds of the area of the cornea, is a faint, almost circular disc of a yellowish-gray, flocculent material or coagula. It is beneath the epithelium, which is intact and glistening. The discs seem to be composed of groups of flocculent material which lie beneath Bowman's membrane and in the anterior layers of the stroma, as though they were resting between the membrane and the stroma. Here and there are glistening points, like crystals. At the apex of the summit there are two larger bodies, looking very much like bubbles, of about 1½ mm. in size, which project forward beyond the general surface of the cornea.

These discoid areas terminate somewhat unevenly, and are not sharply circumscribed by a continuous line, as is

so frequently seen in cicatricial deposits and other infiltrations. These terminations assume an indefinite network in the arrangement of the radiations.

The centers of the discs show condensation, outside of which is a more or less transparent zone, while beyond this is another denser portion which ends in the more or less diamond-shaped reticulations.

The corneal membrane between the areas and the limbus is quite clear and healthy, showing no sign of infiltrate nor of vessels, and through this portion the iris is seen as perfectly as in a healthy eye. The crypts are rather deep; the reactions are prompt. No view of the fundus of either eye could be obtained, but there was a red glare, showing that the vitreous is presumably clear.

The son is aged twenty-six; he is married, but without children. Not until he was sent to school at seven was it known that his sight was poor; by the age of twelve it had become much dimmer. At that time he had attacks of "sore eyes" of short duration, which he said were believed to be the effects of the presence of "wild hairs." He left school at fourteen because he could not see. His eyes were not inflamed after seventeen, nor had there been any greater loss of sight nor other ill health until he was twenty-five, when he had an attack of typhoid fever. On his recovery he counted his eye-sight as worse than before. He has regarded himself to be as healthy as most of his friends, barring his bad sight. He recalls a slight attack of measles, and his teeth decayed early, so that he has worn an upper plate for five years.

At thirteen, he states, he was treated by a physician near his home, but this oculist, with whom I have been in communication, cannot recall his case to me; and two years ago he was treated by another for "interstitial keratitis."

The son's appearance is not so robust as his father's—he seems stunted; his tibias are somewhat bowed and their spines flat. His face is scaphoid and pale, yet his appearance is not typical of the rachitic nor of the luetic diathesis. His disposition is rather taciturn, and he glances about furtively. He seems to have photophobia, yet he does not complain of it. His eyelids are smooth and clear; the globes are not injected; there is no pannus.

In effect, his corneas present the same characteristics as were noted in his father's eyes, except that the discoid opacities are not so dense and betray a somewhat more pronounced reticulation. The surfaces of the corneas are even, smooth, and polished, and they are distinctly sensitive.

The inner two-thirds of each cornea is occupied somewhat eccentrically by an opacity composed of fine grayish dots closely grouped together in ill-defined lines, which are arranged in imperfect lattice or reticulate formation. The dots are from the most minute to ½ mm. in diameter. Just below the center of the summit in the right eye is a distinctly circular nodule, which appears as though it were funneled. To the right of and near to the vertical diameter of the summit in each of the disks is a glistening nodule or bubble which projects beyond the surface, much like those seen in the father's case. In the left eye are two closely united irregular ones with the same character.

The outer one-third of the cornea in each eye is entirely transparent, and contains no opacities, nor could any vessels, full or empty, be seen. Everywhere the epithelium is intact, smooth, and glistening. The irides react promptly; the crypts are distinct, and mydriasis can be easily and completely effected by homatropin. The opacities prevent views of the fundi; there can be obtained, however, red glares, and the retinas are sensitive to the mirror reflections, as were shown by the iris reactions.

While I have seen instances of nodular degeneration of the cornea, I have not seen corneas marked in the way these four are. The opacities are circumscribed and bilateral, of approximately equal size in each eye, and each person's like the other, except that the son's are less dense, or rather the lines are not so numerous. At first glance they looked like the residue of an interstitial keratitis, which image a closer inspection immediately dispelled. At the center of the patches the masses are so close together as to be without arrangement—it is only in the periphery that the reticulation is apparent.

Here are two cases of degeneration of the cornea of unusual extent in a man and his son whose sight has been poor since their earliest recollection, and it has gradually progressed until now they can see objects only. The disease has been bilateral, without inflammatory signs, and has been confined to the central two-thirds of the corneal membrane.

Except for the irregular nodules or bubbles and the crystalloid particles already noted, there are no other anatomic changes. There are no criss-cross latticings of fine threads, as described by Haab in his paper, "Die gittrige Keratitis," * nor in those by Freund.† Nor are there any pigment-like deposits, as shown in Doyne's and Stephenson's cases.‡ The epithelial and superficial layers of the cornea do not seem to enter into the process, so that, except in the two or three special spots, the surfaces are even, smooth, and polished, just as in Fehr's cases.§ Indeed, I would place my cases among Fehr's, and only claim for them that they are instances of "family degeneration of the cornea."

When one stands some distance from the patients, the corneas do not seem to be diseased, for the irides can be seen through the milky film and the corneal surfaces are polished. The artist, in making the sketches, was not able to depict the deposits as faint as they really are; or rather, it seemed impossible to reproduce them without using masses of the water-color pigments, all of which has made a picture resembling an ordinary leukoma. The drawings were made when the pupils were widely dilated, their edges being at the borders of the corneal opacities. The areas in my cases might be likened to Figs. 3 and 5 in Doyne

* *Zeitschr. f. Augenheilk.*, 1899, vol. ii, p. 235.
† *Graefe's Archiv*, 1904, vol. lvii, p. 377.
‡ *Ophthalmoscope*, 1905, vol. iii, p. 213.
§ *Centralblatt f. prakt. Augenheilk.*, 1904, p. 1.

and Stephenson's cases, yet the fine dots are not so uniformly spread over as in theirs; and also like that in Dimmer's Fig. 1.*

To satisfy myself that they were not of syphilitic taint, for neither man exhibited the facies of that disease, I sent them to Dr. John Laird for the purpose of study by the Wassermann tests. He reported that in each case the hemolysis was complete and the results negative, and he remarked that he was "almost sorry he could not find them positive"—a condition which I too regretted, having in mind the good effects of mercurial preparations in syphilitic diseases of the cornea.

The men were sent home to undergo a short course, in their eyes, of a solution containing atropin, holocain, and dionin, and a pill of calcium lactate. At the end of twelve days they returned, stating that they had brighter distant vision, but as their accommodation had been paralyzed, it was impossible for them to see near at hand as well as heretofore. At about this time my neighbor, Dr. Fenton, saw the men with me in consultation.

In March, through the kindness of Professor Alfred Stengel, the men were admitted to the medical wards of the University Hospital for the purpose of studying the metabolic processes of their nature; I had the hope that some radical chemical aberration might be discovered present in them to throw a light on the etiology of this obscure malady.

Dr. Gordon Saxon, who conducted the studies for eleven days, reported that the urinalysis disclosed nothing of pathologic intent, and that the nitrogen-content in each case harmonized with that found in normal men—practically a negative return. The examinations of the blood disclosed the following characteristics:

**Zeitschr. f. Augenheilk.*, 1899, vol. ii, p. 356.

	FATHER	SON
Hemoglobin	97 per cent.	91 per cent.
Red blood-corpuscles	5,100,000	4,810,000
White blood-corpuscles	8,800	9,400
Differential countings:		
Polymorphonuclears	74	72
Lymphocytes	23	23
Large mononuclears	2	3
Transitionals	1	2
Eosinophiles	0	

In each case the von Pirquet tubercular tests were negative.

When last seen, each man declared himself to be physically improved, but that was only by reason of a better ordered diet which I had prescribed for them. Each believed he had a wider field of vision, but neither could see better than the counting of fingers at ½ meter.

I have the hope that I may be allowed to perform iridectomy in each of these men, with the expectation that the sight may be increased to a serviceable degree.

For obvious reasons, I could not excise portions of these corneas for histologic study. I can only conjecture that the process is a hyaline degeneration of the superficial layer of the substance of the cornea, with probably an involvement of Bowman's membrane.

I do not pretend to assert that the disease is congenital, that is, prenatal; yet it is not at all unlikely that it was in these cases, because of the very early loss of sight: it must have become manifest in their infancy. It is not likely that the degeneration has increased since early childhood; the father does not recall any one telling him that his eyes have changed in appearance, and his elders have regarded the son's case to be identical with his own. I feel safe in stating that neither syphilis nor tuberculosis could have been the cause of the disease in these two men.

DISCUSSION.

DR. WILLIAM ZENTMAYER, Philadelphia: An important point is the differential diagnosis between these cases and those of sequelæ of interstitial keratitis. In naked-eye appearances they resemble one another very closely, but with the corneal telescope they are quite different. The absence of vascularity or blood-channels in the cornea and the uninvolvement of the iris are important points of difference. In the father's case particularly the changes resembled those of interstitial keratitis, probably because the process is so much older than in the son. It is to be looked upon as a hyaline degeneration and not to be due to tuberculosis. The process resembles somewhat that of Groenouw's nodular keratitis, and the consensus of opinion is that this also is not tuberculous. The pictures do not adequately portray the condition. I think it has been done as well as could possibly be done, but still it is not satisfactory.

DR. JOHN E. WEEKS, New York: A few months ago I presented cases, similar to the ones here presented, at a meeting of the Section on Ophthalmology of the New York Academy of Medicine. In the father the degeneration was quite well advanced. The vision was reduced, as far as I can recollect, to $\frac{1}{200}$, while in the son, who is a young man of about twenty-one, the vision was $\frac{20}{70}$. In this family there were three sons and one daughter. I saw the daughter and one of the other sons, and they were free from this degeneration. The remaining son has defective vision. He was in Chicago, and I did not have the pleasure of seeing him. This condition is the so-called family degeneration, and is in all probability inherited. The affection presents various manifestations. In some there is a nodular condition of the cornea, and in some the epithelium is not raised to any great extent, but, as Parsons has said, in all probability in all these cases there is a hyaline degeneration of the superficial layers of the cornea, avoiding Bowman's membrane, in some cases pushing that membrane forward. The density of the opacities tends to increase as the individual grows in years, resembling zonular cataract in this respect. There is no remedy, of course, for the condition. It always appears more dense in the center of the cornea. If we ob-

tain any improvement in vision, it must come from iridectomy. The possible improvement in vision in the cases here presented was apparently obtained when the pupil was dilated, and the patient had the benefit of vision through the clearer portion of the cornea at the periphery.

DR. G. E. DE SCHWEINITZ, Philadelphia: Because Dr. Chance was kind enough to permit me to examine his interesting patients, I may say a word in regard to a patient with similar ocular disease, *i. e.*, familial degeneration of the cornea. A long and thorough trial of tuberculin injections, subconjunctival injections, and massage of the cornea was entirely without effect. The patient seemed to think that his vision improved, but in point of fact there was not the slightest betterment in visual power.

DR. SAMUEL THEOBALD, Baltimore: I have under observation now, and have had for the last eighteen months, a case bearing points of resemblance to those described by Dr. Chance. The patient is a delicate, poorly nourished woman, now fifty-seven years of age. Three and a half years ago a slight nebulous opacity in the center of each cornea was observed for the first time. Eighteen months since the patient reported that the left eye had been uncomfortable for a week or more and the sight blurred. The opacity in the central part of the cornea of this eye was found to be more marked than previously, and the epithelium loosened. Very slight opacity was found in the center of the right cornea, and the sensibility of each cornea was appreciably reduced, a condition which has continued. From that time until the present the case has been under observation, and every conceivable form of treatment has been tried with little, if any, effect. Atropin, dionin, holocain, and eserin locally, quinin, strychnin, iron, potassium iodid, and arsenic internally. The condition improves at times, but the improvement is never lasting. The tension is not what one would call plus, but at times it is above the average, "Tn." The propriety of an iridectomy, not only for visual purposes, but to improve the condition of the eye by lessening tension, has suggested itself, but I have felt some uncertainty as to the wisdom of this measure.

DR. BURTON CHANCE, Philadelphia: I have but little to

say in reply. The special points about these cases are that the corneal surfaces are entirely intact, and there have been no signs of an increase in the intraocular tension in either case. I would like to know how this disease became so marked in the fifth generation of a family, all the members of which have been very attentive to their ways of living, and each has known much about the others. Why it should have appeared in these generations is a point of interest. They are of a Pennsylvania-German family, and it may be that so united a community may have, by their close union, given rise to degeneration in these members, just as was observed in instances of the disease occurring in Alpine villages. I do not pretend to say that their sight has improved, nor have I any hope at all of giving them any better sight, unless it be by the operation of iridectomy, which I have proposed for the men's consideration.

AN EXTREME CASE OF CONICAL CORNEA WITH CATARACT.

DAVID HARROWER, M.D.,
Worcester, Mass.

On March 21, 1912, I saw one of the most extreme cases of conical cornea that I had ever seen. At the apex of the cone the cornea was gray from old cicatrices. This was in both eyes. There was also mature cataract. The patient was sixty-six years of age. The conical cornea had existed for about twenty-five years, and for the last two years, on account of the condition of the lens, this man had to be led about by an attendant. On testing him I found the field of vision good and perception of light fair for distance. The lids were in a very irritable condition, and I advised him to wait until the fall for his operation, as he was in the habit of being away during the summer. He came back in the fall with the lids still irritable, and they were not in good

condition until November 11th, when I operated. The vision at this time was so he could discern the color of one's hand held up about two inches from his eye and somewhat down. I made the ordinary incision for cataract, and the cornea collapsed. I had a good deal of difficulty to engage the lens in the wound, and every time I got it up it would slip back. I finally got it to the opening, and slipping my cystotome down below it turned the sharp point toward the lens, and extracted it so. Everything went nicely back in position, the edges of the corneal wound being nicely in apposition. He made a very good recovery, and was able in the course of six weeks to go about the street alone. He can read Jaeger 10, and can also see the divisions between the bricks on the sidewalk. No glass improves either distant or near vision.

When I sent in the title of this paper, I was reporting a very rare condition in my experience, this being the only one I had ever seen. Since that, on March 19th, I saw another.

Mrs. M. B. came to me with a large ulcer on her left cornea. She had also a case of well-marked conical cornea with cataract. She entered the hospital for treatment for her ulcer, and after that was well came back for her operation for the cataract on her right eye. This I did April 21st. In making my corneal incision, the cornea was so thin that it wrinkled. The incision was made very easily. The lens was expressed with the greatest ease, but the cornea was so thin that it doubled back on itself by the weight of the lens coming down. This I returned in place, and the case has done beautifully.

Before operation, showing gray lens.

After operation, showing black pupil.

KERATOCONUS, WITH REPORTS OF CASES.

JOHN E. WEEKS, M.D.,
New York.

Keratoconus is an affection of early adult life, seldom beginning before the age of fifteen years, and seldom after the age of thirty. It is said to affect women more frequently than men, but of the 15 cases reported here, 8 were men and 7 were women.

The cause of keratoconus is unknown. Bowman found keratoconus in several members of the same family, but similar observations have not been reported by others, and it is doubtful that heredity is a factor. Parisotti,* who made quite an extensive study of the subject, is of the opinion that it is due to a "diminished resistance of the central portion of the cornea, which renders it incapable of bearing the normal intra-ocular pressure. The cause is congenital, probably due to some defect in the structure of the central corneal tissue." He assumes that the elastic fibers are wanting. Lapersonne, in discussing Parisotti's paper, stated that he considered conical cornea to be a "congenital or acquired dystrophia, possibly from an affection of the sympathetic."

Anatomic Findings.—Sulzmann† examined a cornea with keratoconus microscopically. Thickness at the apex of the cone, $\frac{1}{5}$ mm. Anterior epithelium and Bowman's membrane broken here and there, the gap being filled with scar tissue. This tissue was also present between Bowman's membrane and the epithelium. The deeper layers

* Trans. Soc. Française d'Ophtal., 1909.

† Centrabl. f. prakt. Augenheilk, March, 1906.

of the substantia propria were normal. Descemet's membrane was defective in places. Newolina examined a small portion of the apex of a cone. The opacities visible were found to be "due to thickening of the epithelium and to proliferations of connective tissue growing from gaps in Bowman's membrane." Uhthoff examined the eyes of an individual in whom keratoconus had recently developed. "Descemet's membrane was normal in one and ruptured in the other. The epithelium varied in thickness in the center of the cornea, but was normal at the periphery." He agrees with Axenfeld and others in the belief that the rupture of Descemet's membrane is the result, not the cause, of keratoconus. Erdman* examined keratoconus in an eye from a patient fifty-two years of age. There was marked thinning of the corneal tissue. Descemet's membrane was thickened in this case.

In regard to the opacities that appear at the apex in advanced cases, Collins and Mayou† state that many cases are due to a rupture in Descemet's membrane and its endothelium, through which aqueous humor filters into the cornea, causing it to become edematous.

In the beginning keratoconus is rather difficult to recognize. There are four principal objective methods for arriving at a diagnosis:

1. Observation with the ophthalmoscope, which will disclose a myopia at or near the center of the cornea, much greater than at the periphery of the cornea, and a distortion of the retinal image, which distortion changes as the portion of the cornea through which the fundus is observed changes. Observed with the plane mirror, the apex of the cone, when the patient looks at the source of reflected light, gives a bright reflex surrounded by changing concentric shadows on slight movement.

* Graefe's Arch., vol. xxv, p. 88.

† "System of Ophth. Prac.," Pyle, Path. and Bact., p. 510.

2. The retinoscope, which gives the effect of irregular astigmatism, the reflex from the cornea being small at the apex of the cone, and elongated into an irregular wedge shape at the sides of the cone, the base being toward the periphery of the cornea.

3. The keratoscopic examination, by means of Placido's disc, which is well illustrated in the plate by Perot,* the image of the disc figure being elongated and broadened toward the periphery of the cornea.

4. The ophthalmometer. This is probably the most sensitive test for the detection of keratoconus in its very early stage, provided the mires are of suitable shape and size. The mires furnished with the instruments of Javal, having the black line running through the center in the direction of the axis of the arc, are well suited for the purpose. When keratoconus is observed in its very early stage even, it will be found that a meridian in which the central dividing lines of the mires when their images are brought into apposition fall in a straight line does not exist (Fig. 1). The cone is not a segment either of a sphere, an ellipsoid, or a parabola, but a mixture of all. The line of the image of the mires is broken at their intersection and frequently slightly curved. The deflection of the lines of the mires at either side of the middle is in the direction of the torsion of the line of least curvature when the radius of that approximate meridian is measured, and in the direction of the line of most acute curvature when the radius of that approximate meridian is being measured, while the images of the mires are broadened in the direction of least curvature. If the image of the combined mires is sharp at their opposing margins, it will be blurred at the margins

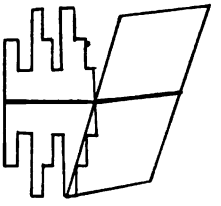

Fig. 1.—Approximate distortion of images of mires.

* Norris and Oliver's "System," vol. iv, p. 250.

of the extremes of the image, the blurring being greatest in that portion of the image lying in the direction of the most acute curvature, because that portion will be most out of focus. The lines of the images are not irregular in the early stage, consequently cannot be confounded with the images of the mires seen in irregular astigmatism due to corneal ulcer or injury. Another point of differentiation is the binocular character of keratoconus. The principal meridians in keratoconus are seldom at right angles, the difference ranging from 1 to 10 degrees. As a rule, the apex of the cone is reached by a more acute curve above than from below, due apparently to the supporting effect of the upper lid to the tissue of the cornea, but the meridian of greatest curvature is seldom directly vertical in its upper half; in fact, it may be found to be at least 45 degrees to either side, sometimes even lying nearer the horizontal meridian.

Pulsation.—Not infrequently, even in a comparatively early stage, pulsation of the apex of the cone may be observed by examination with the ophthalmometer. This is, of course, synchronous with the pulse. The variation in level seldom exceeds $\frac{1}{6}$ mm. The pulsation is largely confined to the stage of progression. I have no record of having observed it in cases that have been stationary for a period of three years or more.

Another peculiarity is that the degree of astigmatism and the axes as determined by the ophthalmometer seldom correspond with those found by means of the trial-lenses.

The following are brief histories of cases observed not requiring operation: The readings from the ophthalmometer indicate axes of meridians of least curvature as nearly as could be ascertained.

CASE 1.—Mr. H. C. F., aged eighteen years, came to my office February 22, 1895. Has grown rapidly—now 6 feet 2 inches tall; is slim, but apparently in good health. Vision

has been failing during the last three years. Has attended school quite regularly, but has not used the eyes excessively.

Status Præsens.—Small crescent, possibly myopic, at temporal side of each disc. Fundus of each eye normal. Ocular muscles—exophoria, 4°; left hyperphoria, 3°. The distorted images of the mires were quite marked.

R. E.: Tn. Ophthalmometer 1.5 D.; axes not regular. V. with —4.75s.⌒—1.5c. ax. 60° = $\frac{20}{70}$.

L. E.: Tn. Ophthalmometer 0.5 D.; axes not regular. V., with —0.75s.⌒—0.75c. ax. 130° = $\frac{20}{20}$.

April 2, 1900; V. R. E.—4.5s.⌒—2c. ax. 30° = $\frac{20}{50}$+; L. E. —1.25s.⌒—1.12c. ax. 117° = $\frac{20}{50}$ —.

March 19, 1905; V. R. E. —4.25s.⌒—2.25c. ax. 30° = $\frac{20}{70}$ —; L. E. — 2s.⌒—2.75c. ax. 160° = $\frac{20}{50}$ +.

May 2, 1907; V. R. E. —5s.⌒—2.5c. ax. 35° = $\frac{20}{70}$; L. E. —1.5s.⌒—4.5c. ax. 154° = $\frac{20}{40}$ —.

April 14, 1912; V. R. E. —4.5s.⌒—2.5c. ax. 23° = $\frac{20}{100}$; L. E. —1.5s.⌒—4.5c. ax. 157° = $\frac{20}{50}$ —.

In this case the vision in seventeen years fell from $\frac{20}{70}$ to $\frac{20}{100}$ in the right eye, and from $\frac{20}{20}$ to $\frac{20}{50}$ in the left, with marked increase in the astigmatism in both eyes, the peculiarity of the corneal images increasing in both eyes. The affection began at the age of fifteen years; the development in both eyes virtually ceased at the age of thirty years.

CASE 2.—Mr. S. M. B. came to my office March 16, 1895. The condition of refraction was: V. R. E. — 5 c. ax. 75° ⌒+7 c. ax. 158° = $\frac{20}{70}$—; L. E. —6 c. ax. 132° ⌒+6 c. ax. 38° = $\frac{20}{70}$ +. Tn. The characteristic images of the mires were observed on examination with the ophthalmometer. The patient has not been seen since.

CASE 3.—Mr. S. L. N., aged thirty-seven years, came to my office April 6, 1907, referred by Dr. Posey, of Philadelphia. Has had difficulty in the use of the eyes for six or seven years. Has not obtained relief from the use of glasses. Sees well if he makes a stenopaic slit of eyelids. Has quite severe dull pain back of eyeballs, accompanied by nausea on use of eyes. Six months ago the refraction was: R. E. +1.25c. ax. 145° = $\frac{20}{40}$+; L. E. +0.50s.⌒+0.50c. ax. 30° = $\frac{20}{30}$.

Status Præsens.—The ophthalmometer measurements are: R. E. Astigmatism 3.25 D., lesser axis 45°; L. E. 3.5 D., lesser axis 153°. Principal axes are not at right angles. The distortion of the images of the mires described above was very evident. R. E. —2.5c. ax. 45° = $\frac{20}{30}$; L. E. —0.50s. ⌒+3c. ax. 25° = $\frac{20}{30}$.

The optic discs in both eyes present an excavation of about 0.4 mm. Tn. in both eyes. Fields of vision not limited.

CASE 4.—Mr. H. Z., aged twenty-eight years, came to my office July 28, 1907. Vision began to be difficult five years ago. Patient is in good health. Has used the eyes excessively for close work. The affection probably began at about the age of twenty years.

Status Præsens.—Cornea clear. V., with correction, R. E. = $\frac{12}{200}$; L. E. = $\frac{10}{200}$. Ophthalmometer: R. E. Astigmatism 8 D., axis 97°; L. E. 8 D., axis 80°. The peculiar distortion of the images of the mires pronounced. V. R. E. —1.5s.⌒+8.75c. ax. 30° = $\frac{20}{50}$—; L. E. —0.50s.⌒+8.25 c. ax. 180° = $\frac{20}{70}$. Fundi normal. Tn.

October 21, 1907, the vision and condition of the eyes were virtually unchanged.

CASE 5.—Mr. A. L. S., aged twenty-one years, came to my office November 22, 1907. Patient has noticed that his vision was imperfect for four or five years. Has never been robust, but has not had any severe illness. Has been studying hard for some years.

Status Præsens.—Cornea clear. No pathologic condition of the interior of the eyes. Ophthalmometer: R. E. Astigmatism 4 D. ax. 45°; L. E. 3.25 D. ax. 130°. Principal axes not at right angles. The peculiar distortion of the image of the mires is pronounced. V. R. E. +3 c. ax. 110° = $\frac{20}{100}$+; L. E. —0.50 s.⌒+3 c. ax. 28° = $\frac{20}{30}$.

April 7, 1909, V. R. E. +3.5 c. ax. 123° = $\frac{20}{100}$; L. E. —0.50 s.⌒+3 c. ax. 28° = $\frac{20}{30}$. Conical cornea very nearly stationary.

CASE 6.—Mrs. E. J. Van D., aged twenty-two years, came to my office February 17, 1908. Has had difficult

vision for a number of years. Patient in rather feeble health.

Status Præsens.—Cornea clear. Fundi normal. Ophthalmometer: R. E. Astigmatism 2.25 D. ax. 50°; L. E. 8 D. ax. 135°. Principal axes not at right angles. Distortion of image of mires marked. Refraction: R. E. — 2 s.◯—2.25c. ax. 50° = $\frac{20}{70}$—; L. E. —3 s.◯—6 c. ax. 132° = $\frac{20}{200}$—. Tn. The change taking place in the cornea is slight.

CASE 7.—Miss E. T. D., aged sixteen years, came to my office October 17, 1908. The difficulty with vision began at the age of ten years. Patient pale, somewhat anemic.

Status Præsens.—Ophthalmometer: R. E. Astigmatism 6.5 D. ax. 28°; L. E. 6 D. ax. 145°. Refraction: R. E. +0.25 s.◯—5.5 c. ax. 20° = $\frac{20}{50}$ +; L. E. + 0.50 s.◯—5 c. ax. 173° = $\frac{20}{40}$. The patient was a school-girl. She was permitted to use the eyes for reading two hours daily at divided intervals.

April 29, 1910: V. R. E. +1.5s.◯—6 c. ax. 40° = $\frac{20}{30}$—; L. E. +0.75 s.◯—6.5 c. ax. 107° = $\frac{20}{50}$+. Patient has been ill. Has used the eyes a great deal.

May 5, 1911.—The refraction is virtually the same as in April, 1910. V., with correction, R. E. = $\frac{20}{30}$; L. E. = $\frac{20}{100}$. The fundi oculorum are normal. The peculiar distortion of the images of the mires is pronounced. Principal axes of the astigmatic error not at right angles.

CASE 8.—Dr. George S. K., aged thirty-four years, came to my office March 25, 1913. Vision was very good until the patient was fourteen years of age, when he was severely ill with typhoid fever. Shortly after his recovery the vision began to be difficult. The change in the cornea apparently began at the age of fifteen years.

Status Præsens.—Patient in robust health. Cornea clear. Fundi normal. Tn. V. R. E. = $\frac{20}{200}$; L. E. = $\frac{10}{200}$. Ophthalmometer: R. E. Astigmatism 5.75 D. ax. 55°; L. E. 4.75 D. ax. 145°. Principal meridians not at right angles in either eye. Peculiar distortion of images of mires pronounced. Refraction: R. E. —1s.◯—9 c. ax. 23° = $\frac{20}{50}$+; L. E. —1 s.◯—9 c. ax. 153° = $\frac{20}{100}$. Patient thinks that the process has been virtually stationary for some years.

CASE 9.—Mrs. H. T. D., aged thirty-eight years, came to my office April 4, 1913. Patient in fairly good health. Has never used the eyes to excess for reading or other close work.

Status Præsens.—Ophthalmometer: R. E. Astigmatism 4.5 D. ax. 55°; L. E. 2.87 D. ax. 130°. The principal axes were not at right angles. The peculiar distortion of the images of the mires was present. Refraction: R. E. —1.5 s.⊂—0.5 c. ax. 85° = $\frac{20}{30}$+; L. E.—0.50s.⊂—2.5 c. ax. 103° = $\frac{20}{20}$—. Inability to use the eyes with comfort began five years ago.

May 2, 1913: Condition virtually the same. The patient is now using the eyes with comparative comfort.

Treatment of conical cornea may be divided into the non-operative and operative measures; the non-operative into systemic and local. Bradfield* thinks that the treatment should begin by correcting errors in the general health. The author is of the opinion that attention to the health is of value in the early stage of the development of keratoconus, and that the patient should be carefully directed regarding the use of the eyes. Locally, the instillation of pilocarpin and the application of a light compress bandage at night may be of value, but the treatment must be long continued, extending over six to eight months, at least, to produce any beneficial results. Suitable glasses in the early stage not only improve vision, but apparently aid in retarding and limiting the progress of the affection. (See Cases 4 and 5.) The discussion of special optical measures is purposely omitted.

The operative procedures resorted to have been many. Von Graefe's method was to produce an ulcer at the apex of the cone by removing a small piece of corneal tissue without perforating the cornea. After twenty-four to forty-eight hours the exposed area was treated with the mitigated stick of nitrate of silver, the cauterization being

* *Amer. Jour. Ophth.*, Oct., 1903.

repeated every third day for two or three weeks. Paracentesis through the floor of the cornea was performed and repeated every second day for a week, when healing was permitted to take its course. A compress bandage was employed throughout, and subsequently, when the contraction and flattening were complete, a narrow optical iridectomy was performed.

Bader's method consisted in removing a small elliptic flap of the cornea at the apex of the cone and bringing the margins together by one or two fine sutures. Some operators place the ellipse vertically, others horizontally. Anterior synechiæ occur in a number of the cases. Optical iridectomy is required.

Mr. Morton's operation* is a modification of Bader's operation.

Sir William Bowman's method consisted in removing a disc from the apex of the cornea with a small trephine. Cicatrization of the wound proceeds under a compress bandage, producing the desired flattening.

Multiple puncture of the cone at its apex, using a fine cataract needle, has been employed. The apex of the cone is punctured four to six times at one sitting, repeating it at intervals of two to three weeks. The pupil is kept contracted by eserin and a compress bandage used throughout. "Eventually a network of connective tissue forms which flattens the cone without producing much corneal opacity."

A procedure largely practised is the application of the electrocautery or thermocautery. The cautery is applied in various ways. Sir A. Critchett "first applies the cautery at a black heat to the entire area to be cauterized. Within this area a little more tissue is destroyed by an increased heat, while the very apex is touched with a cautery at a

* *Brit. Med. Jour.*, 1880, p. 623.

dull red heat. One sitting is sufficient" (Swanzy). Gayet* carried the cauterization to perforation at the apex. Knapp† always endeavored to make the perforation as small as possible. He was of the opinion that perforation was essential to success. A modification of the ordinary application of the cautery is advocated by Elschnig.‡ He endeavors to induce vascularization of the cauterized area, believing that it produces a firmer cicatrix. In order to encourage vascularization he connects the central cauterized area by a rather broad cauterized strip to the limbus in a portion of the cornea that will not interfere with the pupillary area. He does not perforate, nor does he think that iridectomy is necessary or desirable. Tattooing of the cicatrix is resorted to in some cases. In order to avoid a dense scar at the center of the cornea Dodd§ employs the galvanocautery, making a series of cauterized points about 1 mm. apart in the form of a horseshoe, about the apex of the cone, the uncauterized base of the shoe being upward, leaving the pupillary area free. The cauterization can be repeated if necessary. Grossmann‖ advocates cauterizing the cone with superheated air, employing a special apparatus for the purpose.

Angelucci** introduced a purse-string suture around the apex of the cone, the suture passing in the substantia propria between Bowman's and Descemet's membranes. The apex of the cornea was cauterized and a portion excised by means of a Graefe knife. The suture was removed in eight days. Vision was improved.

In the study of keratoconus it occurred to the writer that in order to bring about suitable permanent reduction

* *Lyon Médicale*, xxx, 1879, also Tweedy and Knapp.
† Norris and Oliver's "System," vol. iii, p. 825.
‡ *Wiener klin. Rundsch.*, 1904, 20.
§ *Med. Press and Circular*, February, 1903.
‖ *Brit. Med. Jour.*, Aug. 26, 1905.
** *Bull. de la Soc. Belge d'Oph.*, No. 29, p. 56, 1910.

of the cone by operative procedure it was necessary to reduce the tension of the eye as much as possible and to maintain the hypotony for a long period of time; that is, until the healing was complete and the cicatrices firm. To this end it was thought advisable to perform iridectomy, placing the coloboma where it would ultimately be of greatest aid to vision because of its well-known tendency to reduce intraocular tension, and, at the end of one or two weeks, to apply the chosen procedure to the apex of the cornea, following this by the use of pilocarpin and a compress bandage. In the five operated cases reported this plan of procedure was followed. An iridectomy back of clear cornea, upward, upward and inward, or upward and outward was performed. Ten days later the apex of the cone was cauterized, the cauterized area being oval, its long axis horizontal, and seldom extending above the horizontal meridian of the cornea. Cauterization was performed with a platinum point heated to a red heat in the flame of a spirit-lamp. The eschar was carried as deep as possible at the apex without perforating the cornea. The subsequent treatment consisted in the use of borated vaselin, pilocarpin, and a compress bandage, the bandage being applied continuously for three weeks and at night for two months.

The following are the reports of cases treated as described above:

CASE 1.—Mr. J. S. B., aged twenty-seven years, consulted me at my office May 26, 1895. In 1890 patient was an excellent shot. Was a stenographer in government employ at Washington, worked arduously during the day and attended night school, used the eyes day and night. First noticed failure of vision in the spring of 1891. Up to the spring of 1893 patient had consulted four quite well-known ophthalmologists, all of whom failed to make a diagnosis. Had many changes of glasses. Was treated by internal medication, electricity locally, etc. Consulted the

late Dr. Bell, of Washington, in the spring of 1893, who made a diagnosis of keratoconus. Saw the late Dr. H. Knapp early in the year 1895, who gave glasses, but advised against operative procedure.

When examined by me, the ophthalmometer gave the peculiar images of the mires always observed in keratoconus. R. E. Astigmatism 7.5 D. ax. 10°; L. E.—Astigmatism 10 D. ax. 160°. The left cornea pulsated, the difference in the refraction at the apex of the cone being 1.25 D. between diastole and systole. V., without correction, R. E. = $\frac{9}{200}$; L. E. = $\frac{1}{400}$. With correction, R. E. + 1 s.⌒—7 c. ax. 85° = $\frac{20}{40}$—; L. E., with best glass possible—$\frac{3}{200}$. With correction and stenopaic slit V. R. E. = $\frac{20}{30}$—; L. E. = $\frac{20}{200}$.

In June, 1899, I performed iridectomy on the left eye and later cauterized the apex of the cone. On November 6, 1900, V. R. E., + 1.5 s.⌒— 7 c. ax. 85° = $\frac{20}{50}$ +; L. E. —2 s. ⌒ — 2 c. ax. 140° = $\frac{20}{200}$ +. On November 19, 1908 (when last seen), V. R. E. + 2.5 s.⌒— 6 c. ax. 86° = $\frac{20}{30}$ — ; L. E.—2 s.⌒→2 c. ax. 140° = $\frac{20}{200}$.

It is interesting to note the change in the corneas as indicated by the Javal measurements. While the June reading gave 7.5 D. ax. 10° in the right eye at the first measurement, it was found that the best visual results were obtained with the axis of the cylinder at 85°. In September, 1896, the Javal gave astigmatism 6 D. ax. 90°; November 19, 1908, 6 D. axis 87°. The left eye by Javal gave astigmatism 10 D. ax. 10° before operation, 0.5 D. ax. 20° shortly after operation, and, at the last measurement, November 19, 1908, 1.5 D. ax. 105°.

In this case the condition of the right eye was virtually stationary when the patient was first seen by me. The refraction has changed from hyperopia 1 D. in the meridian of least curvature to hyperopia 2.5 D. Since the operation the astigmatism of the left eye has changed from 0.5 D. ax. 20° to 1.5 D. ax. 105°. Both eyes have been stationary during the last two or three years.

CASE 2.—Miss M. F. C., age fifty-four years, came to my office December 31, 1911. Has never suffered any severe illness. Is now in good health. Began to have trouble

with vision at about the age of nineteen years. Difficulty increased to the age of thirty-five years, since which time there has been but little change. Ten years ago was operated on the left eye by Pagenstecher at Weisbaden, who did an iridectomy to the temporal side, cauterized the apex of the cone, and tattooed the scar.

Status Præsens.—Right eye: Pronounced conical cornea. Three small white spots at the apex of the cone, also some haziness of the cornea involving the cone and extending almost to the periphery below. V. = $\frac{2}{200}$; improved to $\frac{6}{200}$ with a mydriatic; not materially increased by the use of glasses or pin-hole diaphragm. Javal unsatisfactory. Fundus normal. Tn. No pulsation of apex of cone.

Left eye: Cornea conical. Tattooed at apex. Coloboma outward. Cornea hazy except in upper third. V. = $\frac{6}{200}$ improved to $\frac{8}{200}$ with glasses. Fundus normal. Tn. Reads ordinary type with difficulty by holding the page close to the face.

In the belief that, by reducing the acuity of curvature of the cornea, and by placing the pupil opposite the clearest portion of the cornea, better vision could be obtained, I advised an iridectomy and a subsequent cauterizing of the apex of the cone.

October 10, 1912, iridectomy right eye upward. Operation smooth. Healing uneventful. December 20, 1912, V. = $\frac{8}{200}$. January 2, 1913, cauterized the apex of the cone. Dressings daily, introducing borated vaselin (3 per cent.) into the right eye and afterward applying a light compress bandage. This was continued three weeks. February 12, 1913, V. R. E., with—6 s. = $\frac{20}{100}$. Curvature of cornea much reduced. Tn. February 18, 1913, epithelium over area of cauterization vesicular. Condition similar to recurrent erosion keratitis. March 4, 1913, as the corneal epithelium at the apex of right eye did not become firmly adherent, patient was referred to the Infirmary, the cauterized area thoroughly curetted, borated vaselin introduced, and the eye bandaged. The epithelium readily reformed, but ten days later again became detached. Hot bathing, t.i.d. one hour at a time, was advised. March 27, 1913, eye smooth. Curvature of cornea greatly reduced in acuity. April 9, 1913, V. R. E., with glasses = $\frac{20}{200}$ +.

Reads Jaeger 5 fairly readily. The vision appears to be gradually improving.

CASE 3.—Mrs. P. L. B., aged thirty-seven years, came to my office October 16, 1906. Patient of medium height, apparently in good health. Vision began to fail at the age of twenty-three years, and has failed rapidly during the last three years. Does not use the eyes excessively for close work. Diagnosis: Conical cornea. With the exception of the corneas the eyes are normal. Tn.

Status Præsens.—Right eye, ophthalmometer 1.5 D. ax. 5°. Curvature of cornea not regular in any meridian. The approximately principal meridians not at right angles. V. with —1 s.⌒+5 c. ax. 5° = $\frac{20}{50}$+. Tn. No pulsation.

Left eye. Ophthalmometer 3 D. ax. 90°. Curvature of cornea not regular in any meridian. Principal meridians not at right angles. V. with +4.5 s.⌒—9.5 c. ax. 105° = $\frac{20}{100}$+. Cone pulsates, the movement of the apex being about $\frac{1}{10}$ mm. Two very small grayish spots at the apex of the cone.

October 10, 1910, V. R. E.—2 s.⌒+6 c. ax. 177° = $\frac{20}{40}$+; L. E., with correction as above = $\frac{15}{200}$.

January 14, 1913, V. R. E.—1.5 s.⌒+6 c. ax. 177° = $\frac{20}{40}$. Although the astigmatism during the six and one-third years of observation had slightly increased in this eye, the vision with correction had slightly increased and the eye appears to be now at a standstill so far as the keratoconus is concerned. Left eye: V., with correction, = $\frac{2}{200}$—. During the same period of observation the vision had fallen from $\frac{20}{200}$+ to counting fingers at two feet. The apex of the cone was below the horizontal meridian of the cornea; the opacities at the apex had coalesced and enlarged. Operative procedure was advised for the left eye, and an iridectomy upward was performed January 14, 1913. Ten days later the apex of the cone was cauterized. April 22, 1913, V.—2 s.⌒—3 c. ax. 60° = $\frac{15}{200}$. Patient complains of some photophobia. Eye quiet.

CASE 4.—Miss Margaret V., aged twenty-five years, referred to me by Dr. Dobson, of Poughkeepsie, December 6, 1912. Height about 5 feet 11 inches. Attained present stature at about the age of sixteen years. Grew rapidly.

Has lived in the country, much out-of-doors. No history of excessive close use of eyes. Is now strong and robust. Noticed beginning of impairment of vision at age of sixteen years. Vision has grown decidedly worse during the last three years.

Status Præsens.—Right eye: Pronounced keratoconus; apex slightly below the center of the cornea, transparent. Javal 14 D. of astigmatism, axis approximately 180°. Eye normal except the corneal condition. Tn. V. $=\frac{3}{200}$, with pin-hole diaphragm $=\frac{20}{200}$, with —9 c. ax. 180° $=\frac{20}{200}$.

Left eye. Pronounced keratoconus. Apex of cone below the horizontal meridian. Small opacity at apex. Slight haziness of cornea about apex and slightly below. Pulsation causing bulging of cornea about $\frac{1}{6}$ mm. at each systole. Eye normal except for the corneal condition. V. with pinhole $=\frac{18}{200}$, not improved with glasses. Tn.

On January 9, 1913, the patient was admitted to the New York Eye and Ear Infirmary, and an iridectomy was performed on the left eye. Healing uneventful. January 21st, apex of cone cauterized. Eye kept under a light compress bandage three weeks and bandaged at night three weeks longer. Recovery uneventful.

February 13th, iridectomy upward performed on the right eye. Healing uneventful. Apex of cone cauterized February 22d. The eye was kept under a light compress bandage three weeks and bandaged at night three weeks longer. Recovery uneventful.

March 25, 1913, tension of both eyes slightly minus. Condition excellent. V. R. E. +3 s.⌒—10 c. ax. 13° $=\frac{20}{100}$; L. E. +1 s.⌒—10 c. ax. 170° $=\frac{20}{100}+$. Reads Jaeger 2 with facility.

Advised the use of pilocarpin muriate, 0.75 per cent., once daily for the purpose of keeping the tension low until the cicatrix becomes firm. Compress bandage at night.

CASE 5.—Victor B., aged thirty-seven years, came to my clinic at the New York Eye and Ear Infirmary on March 25, 1913. Has always been near-sighted. Vision began to fail eight years ago. Has always read much at night as well as in the daytime. Has always been well. In August,

1906, the apex of the conical cornea of the right eye was cauterized by an ophthalmic surgeon.

Status Præsens.—Pronounced keratoconus in both eyes. Vision $\frac{5}{200}$ each, improved but little with glasses. Apices of cones slightly below the horizontal meridian of the cornea. Very slight pulsation. There was a long, narrow, irregular opacity at the apex of the cone of the right eye, not very dense, probably largely due to the cauterization, a minute opacity at the apex of the cone of the left eye. March 27th, iridectomy upward, left eye. April 6th, cauterized the apex of the cornea, left eye. May 3d, V. L. E., without correction $= \frac{18}{200}$; with correction $= \frac{20}{100} +$.

An analysis of the foregoing cases goes to show that when the vision in keratoconus has fallen to $\frac{8}{200}$ or less, it may be improved very much by the operative procedure described. In case 1, which has been under observation fourteen years since the operation, the cornea has remained unchanged. That complications may arise is evident from Case 2. The recurrent detachment of the epithelium from the cauterized area was apparently due to reduced vitality in an individual of advanced years. The inference from the observation of the behavior of the corneal epithelium in the other cases is that, in young individuals, the complication will probably not occur because of a more vigorous state of vitality of the corneal tissue.

Photophobia is complained of by some patients, but this annoying symptom appears to be very transient.

In regard to other operative procedures, it occurs to the writer that large central perforations, either by trephining or by cauterizing, may lead to fistulæ, occasioning no little annoyance in their closure. Meller cautions against using a trephine more than 1 mm. in diameter.

DISCUSSION OF PAPERS OF DRS. HARROWER AND WEEKS.

DR. EDWARD JACKSON, Denver: I have within the last year had a case of extreme conical cornea following a per-

foration of the cornea in trachoma. The girl was not more than five years old when there was a small perforation in one eye, near the outer margin of the cornea, and the cornea subsequently became quite conical, not so high a degree of conicity as in Dr. Harrower's case, but still unusually marked. In that case the lens has been removed by discission, with a resultant myopia of 17 D. The vision is improved somewhat by the concave lens, but it is scarcely adequate for reading large type.

DR. ROBERT SATTLER, Cincinnati: I have long shared similar views to those so fully stated by Dr. Weeks. More recent observations and clinical facts pertaining to keratoconus strongly incline me to a complete change of viewpoint of the commonly accepted pathogenesis. To me it appears probable that it is a developmental tissue aberration of the central regions of the cornea which, under certain exciting conditions after birth, generally during early adolescence, but also after spontaneous arrest for longer and variable time periods, again advances during senescence. This physical globe deformity or advancing conicity of the cornea seems to be accompanied first by a gradual giving up and finally by a complete loss of its already anatomically restricted elastic quality, so that it (the cornea) can no longer contribute its smaller share toward the conservation of a commensurate or more or less normal globe resiliency. In other words, it gives up in part or completely its own share or property of compensation, which, as already stated, it has in common, but in a much lesser degree, with other regional points or localities of the protective tunic. The anatomic factors on the part of the latter which aid in keeping up normal tension or a more or less perfect balance between adequate nutrition and uninterrupted function are the natural or inherent tissue resiliency of the protective tunic itself (sclera and cornea), reënforced by available compensating tissue qualities, first at the posterior pole of the globe, *i. e.*, a greater or lesser elastic property on the part of the lamina cribrosa and at the anterior pole a much lesser degree of reserve elasticity, but with sufficient pathologic proof that it has been present and was lost is furnished us by prodromal symptoms and those which precipitate an attack of acute

inflammatory glaucoma. The other factors which maintain and preserve globe resiliency or adequate globe fulness are the vortex scleral canals, the many openings for the long and short ciliary arteries, and the numerous veins, and doubtless also a certain proportional share of globe tension is conserved through an active tonicity of the recti muscles and other tendinous scleral insertions.

The clinical observations some years ago, and which have since been repeatedly confirmed by me, disclosed that a striking and unmistakable conic physical defect of the cornea was marked or accompanied by the absence of pitting, even of the optic papilla, and no trace of a physiologic excavation. From this, and, as already stated, corroborated observations since then, it appears probable to me to assume that, if one of the natural safeguards for the permanent conservation of globe resiliency or elasticity or normal tension is invalidated or lost in consequence of congenital developmental causes, it may accentuate one or all and force one or several to give up in part or altogether their property of compensation—a rigid, flat, or otherwise physically deformed cornea—a deep physiologic, or later pathologic, excavation. A rigid sclerosed or absent embryologic cleft at the posterior pole, *i. e.*, a flat optic papilla, may force its anterior compensatory complement, the central region of the cornea, to give up its elastic property also, and, as a necessary consequence, a visible deformity results.

The case referred to by Dr. Harrower is paralleled, though not in the same degree, by a similar observation. The patient was a woman, aged fifty-five, with congenital keratoconus of both eyes, which was spontaneously arrested for many years, but during recent years again slowly and steadily advanced until her vision sank below a level of 0.1. An iridectomy on one eye, preliminary to other surgery, was attended by such marked improvement of vision that she expressed herself satisfied and declined further surgical aid. With proper optical correction she resumed her duties as a school-teacher, and to my surprise has continued her work without interruption for almost two years.

DR. C. H. BEARD, Chicago: Some fifteen to seventeen years ago I reported a case that gave me some new ideas in

regard to the treatment of keratoconus that I have since put into practice with considerable success. This case came to me on account of high myopia, 22 D. in one eye and 24 D. in the other. The patient was a woman, thirty-five years old. With the best correction she got vision of only about $\frac{20}{100}$. With a view to relieving her condition I advised removal of the crystalline lenses. She seemed not too old to remove the lenses by discission. I performed several discissions on either eye, meantime keeping the eyes snugly bandaged, and the process took a long time. I know she was thirty-six when I first operated on the second eye. Much to my surprise, when the case was discharged the corneal cones, which had been extreme, had almost disappeared, and the vision was $\frac{20}{20}$ and $\frac{20}{30}$. Since that time I have used very conservative measures in the management of these cases of keratoconus, chiefly paracentesis of the anterior chamber, followed by prolonged bandaging and the instillation of miotics. After discharge the patient, or some member of the family, is instructed to do the bandaging. Any time they will submit to it, the eyes are bandaged in the daytime, and it is always done at night. With regard to the dystrophic nature of keratoconus, almost all my cases have been in young women of perfectly robust health. I am speaking now of idiopathic keratoconus. An interesting objective symptom that has not been mentioned here is the peculiar twinkle of the eye, caused by the play of the corneal reflex around the cone, also due in part to the shifting or movement of the iris and pupil as seen through the cone.

DR. WILLIAM H. WILMER, Washington, D. C.: It has always seemed to me that the use of pilocarpin was illogical. If you contract the base of a cone, you lengthen the apex. The use of pilocarpin does give the patient temporarily better vision by reducing the size of the pupil, but it seems to me that the prolonged use of this drug would have a tendency to increase the conical cornea. In the beginning of these cases a great deal can be done to help the condition—First, by getting the patient to give up close eye work. There are many fields of activity open to men who are suffering from this affection—the orchardist, expert dairyman, farmer, etc. The eyes are much helped by the patient's

giving up books and going to the farm. Second, a great deal can be done by the frequent changing of the glasses to meet the frequent changes in the error of refraction. Third, building up the general health has a decided value in these cases. In my experience, while this condition does occur in robust people, it often appears in those who are run down and anemic. It is true that I have seen it among negroes who were not only very robust, but who would pass perfect physical examinations. The great thing in these cases, at the beginning, is to give up close use of the eyes and thus relieve the strain on the ciliary muscles.

DR. W. H. WILDER, Chicago: I should like to ask Dr. Weeks whether he has made any special study of the insensitiveness of the tip of the conus. We are familiar with the fact that the tip of the conus is so insensitive that the patient experiences no sensation when it is lightly pressed with the end of a probe. Whether or not the anesthetic area becomes larger with the progress of the condition, and whether such a test may prove of any practical value in determining such advance, might be of importance in the study of these cases.

In connection with the subject of treatment by means of the cautery, I should like to mention a little procedure I practised, with marked improvement in one case, in which the tip of the conus had not become very thin. Instead of making a scar at the tip of the conus, I made, with the cautery, four lines from near the limbus up to within 2 mm. of the center of the cornea. These cauterized lines were somewhat wider as they approached the limbus, and were symmetrically placed in each quadrant so that they resembled a cross, interrupted where they would intersect if continued, so that the center of the cornea was clear. The contraction of these scars tended to flatten the tip of the conus, and I was gratified to find a distinct improvement in the vision over a period of four or five months during which time I had the patient under observation.

DR. T. Y. SUTPHEN, Newark, N. J.: Eighteen years ago I saw two marked cases of keratoconus in the same family. One of them, a young girl, fifteen years of age, I treated with the galvanocautery. She was highly myopic, with a marked

cone, and able to see only the largest type with highest glass that I could give her. Cauterization was made and repeated directly over the apex. Her vision was improved, but not so very greatly. I saw that same girl about three months ago. She had married, had grown strong and vigorous, had four children, and her vision was as good as it was directly after the operation. The other case was her younger brother, who had a marked cone in each cornea, with a chronic conjunctivitis. I did not operate on him, as his health was poor and he was catarrhal. He went West, and subsequently lost one eye. I learned later that it had to be enucleated on account of serious inflammation. I mention these cases as pointing to the fact that an improvement in the general condition seems to stay the disease, and vice versâ. I think the new life that this young girl followed had made her more vigorous and resistant to the progress of her eye trouble. With the boy, my impression is that his strumous catarrhal condition, with a long-continued conjunctival inflammation, had a tendency to make him worse.

DR. WM. CAMPBELL POSEY, Philadelphia: I desire to refer to an operation which I have recently described in Knapp's *Archives*. The aim of this operation is to produce, by cauterization, a large, dense triangular scar in the cornea, the apex of the triangle representing the summit of the cone and the base the corneal periphery. The cauterized area comprises about one-sixth of the entire structure of the cornea. The burning of the tissue should be deepest at the periphery and lightest at the apex of the cone. Success from cauterization lies in replacing the greater part of the cone by a mass of firm connective tissue, which should be so placed that the traction exerted by the scar in the process of healing is sufficient to resist the intraocular pressure, while its density should be great enough to prevent rays of light from penetrating it, thereby reducing aberrant refraction. As the apex of the cone seldom occupies the pupillary center, the resultant scar need not entirely block the pupil, so that iridectomy is, as a rule, unnecessary. As Elschnig has pointed out, prompt vascularization of the cauterized mass is most desirable, and I connect the wound in the cornea with the

conjunctiva by carrying the cauterization almost to the limbus.

In the case referred to in my paper uncorrected vision was improved in each eye from less than $\frac{5}{60}$ to $\frac{5}{22}$. Corrected vision in the right eye was $\frac{5}{12}$; in the left, $\frac{5}{7.5}$. Type 0.75 D. was read with ease with each eye without a glass.

DR. ALLEN GREENWOOD, Boston: I want to advocate a little earlier operation than seems to be generally done. A patient, with vision of less than $\frac{20}{200}$, is almost invariably bettered by a proper cauterization. I have operated on four cases, and I am positive that all these patients would testify to the great benefit of the operation. One young boy whom I operated on this spring had a vision of $\frac{20}{200}$ with a glass, much less without a glass. Today he has a vision of $\frac{20}{70}$, with a very dense white scar, which he can see around through a crescentic area of clear cornea, and can read newspaper type. He certainly is very grateful. I think it is better to do the cauterization without waiting too long.

DR. WILLIAM ZENTMAYER, Philadelphia: If one will look back over the literature of twenty years ago, he will there find an admirable paper by Dr. James Wallace, of Philadelphia, on the refraction of conical cornea with miotics. Some of the visual results were brilliant, and were attained by the use of high cylinders. In some instances the cylinders were crossed, the axes crossing at less than right angles. The improvement in vision was not only for the time that the miotic was being used, but continued after the pupil had resumed its normal size. I have used this method since the publication of this paper, and can speak highly of its value. Of course, it does not take the place of operative measures where the conicity is of a very high grade or where there is apical scarring.

DR. W. B. LANCASTER, Boston: About a dozen years ago I made some experiments on rabbits' eyes, to see whether I could learn the best way to make the cauterization for keratoconus. As you all know, it is easy to cauterize a cornea so as to produce almost no reaction by using a very hot tip applied very briefly. You get a nebulous haze and a little injection, but practically no pain, and the cornea heals up,

leaving a facet. I was disappointed to find, however, that the less the reaction, the less beneficial the operation promised to be. This was shown by the sections which Dr. Verhoeff made of the corneas after healing. When the operation was done so as to produce the minimum reaction, tissue was destroyed, and no new connective tissue was formed to take its place. On the contrary, the cornea was actually weakened, so that it was evident that the proper way to do the cauterization is not to aim at the minimum reaction, but rather, while destroying as little tissue as possible, to produce *considerable reaction*, so as to *stimulate proliferation* of new connective tissue. I think you have all had cases where the reaction after this operation was alarming, so that it was feared that harm had been done. Some of these cases are the very ones which turn out best; whereas, in cases with a very slight reaction, the result is disappointing, for the reason that I have indicated.

DR. DAVID HARROWER, Worcester, Mass.: I wanted to hear of some other cases of conical cornea with cataract, but none were mentioned. In the first case the cornea remained practically the same, maintained its conicity about as much as before the operation. In the second case the cone had almost entirely disappeared, but that was only two weeks after the operation.

DR. JOHN E. WEEKS, New York: I am very glad that the subject has awakened so much interest. In regard to the health of the patient: two of my patients were rather anemic and in poor health; the others were apparently quite robust. As to the influence of the use of the eyes on keratoconus, it is important, in my opinion, that patients should be restricted in the use of the eyes for close work. Outdoor life is desirable. The tissues of the eye, other than the cornea, in the eyes that I have studied have remained normal. In regard to operative procedure, if the cauterization is done so as not to include the apex of the cone, the visual result will not be very good in many cases, because the corneal tissue at the apex is frequently hazy. The haziness tends to increase below, and an iridectomy, if it is to be of visual value, should be made beneath clear cornea, in the majority of cases above and to the temporal side, beneath the portion of the cornea

which is most exposed by the upper lid when the lid is raised. The thin area is ordinarily oval, with the long axis lying either horizontally or dipping a little. When iridectomy is done, this portion of the cornea will collapse, while the rest of the cornea remains rigid. If the weakened area is not cauterized and supported by cicatricial tissue, a minor cone may develop at one side of the cauterized area. I have observed that in one case. The cauterization done by Posey is good, provided the cauterization of the cone is extensive enough. The principle involved in making the iridectomy is one of reduction of tension, and that is also the principle that I endeavor to carry out in the use of miotics. I do not think that the reduction of the base of the cone by use of the miotic, as mentioned by Wilmer, plays much, if any, part, particularly after iridectomy and cauterization. If these cases are recognized early and precautions regarding the use of the eyes are carried out, I think they can be arrested; much as a progressive myopia is arrested by the use of proper glasses and precautions regarding the use of the eyes.

DR. ROBERT SATTLER: Were any tonometric examinations made?

DR. WEEKS: I made tonometric examination in only two cases after operation; in these the tension was below the average normal. I followed usually the old method of palpation. In none of the cases have I determined any increase of tension.

DR. W. H. WILDER: May I remind Dr. Weeks that he did not reply to my question in reference to the insensitiveness of the cornea?

DR. WEEKS: While I have used the probe on the tips of the cone, and found that the sensitiveness was less than at the periphery, I have not studied these cases with the idea of ascertaining how the area of insensibility conducted itself as the case progressed.

INTERSTITIAL KERATITIS OF LUETIC ORIGIN.

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On account of its chronic nature and its great resistance to treatment, interstitial keratitis of hereditary syphilitic origin is a disease which usually excites little interest in the clinic, and is of the most trying nature to the ophthalmologist and to the patient in private practice.

It belongs to the eye diseases of moderate frequency, occurring in the statistics collected by Hoor,* comprising 475,000 cases, 3,026 times, a percentage of 0.63. In some 77,000 new cases at the Massachusetts Charitable Eye and Ear Infirmary during the past four years the percentage was slightly over 0.4. Probably a sufficiently close average is one case in every 200.

When we look below the surface of this disease, many problems confront us, for the mode of its production is still shrouded in mystery.

Why does it seldom, if ever, develop in the early months of life, at the time when the signs of congenital syphilis are usually in evidence? Why is it sometimes the only outward sign of a hereditary syphilis? Why are the ordinary methods of treatment—mercury and salvarsan, usually so successful in luetic disorders—so comparatively ineffectual here? What progress is being made toward the solution of these problems?

*Hoor: "Die parenchymatöse Hornhaut-Entzündung," Samml. zwangloser Abhandl. d. Augenheilk., Band vii, Heft 7, 8. Bibliography.

There are two widely divergent views as to the nature of interstitial keratitis: one, that the disease is due to the direct action of the spirochæta pallida; while the second holds that it is rather an indirect manifestation of syphilis, and may be classed among the meta- or para-syphilitic affections.

Evidence in favor of the direct infection may be summarized as follows: Von Hippel has published a case of intrauterine interstitial keratitis in a hereditary luetic fetus of thirty-three weeks, and in the cornea Schneider was able to demonstrate spirochætæ by the Levaditi method.

Clausen* has observed a case of interstitial keratitis in a four and one-half months' child with marked signs of congenital syphilis, and found spirochætæ in the cornea.

A number of investigators have found the spirochæta in the intact corneæ of syphilitic fetuses and new-born children.

Igersheimer demonstrated, at a meeting in Halle, in 1910, a section from the cornea of a hereditary luetic boy who had developed a well-marked interstitial keratitis, which showed one apparently undoubted spirochæta. It was stained by Levaditi's method.

Greeff, Clausen, Bertarelli, Mühlens, Scherber, Schucht, Uhlenhuth, and Multzer, besides many others, have produced an interstitial keratitis in lower animals by the injection of syphilitic material into the cornea or anterior chamber.

Another suggestive fact pointing toward a direct infection is to be found in recent work on the so-called para- or meta-syphilitic infection, to which we shall allude later.

The opponents of the direct infection theory take up these points *seriatim*.

In regard to von Hippel's case and that of Clausen,† it is

* Clausen: "Ätiologische, experimentelle, und therapeutische Beiträge z. Kennt. d. Keratitis Interstitialis," Arch. f. Ophth., Bd. lxxxiii, Heft 3. Bibliography.

† Clausen is of this belief himself.

stated that they belong rather to the earlier stages of syphilis than to the later lesions, and the histologic evidence is in favor of such a view.

It has already been mentioned, and is well established, that spirochætæ are often found in the corneæ of hereditary syphilitic infants, and usually give rise to no pathologic process.

Clausen ridicules Igersheimer's attempt to explain the origin of interstitial keratitis by finding a single spirochæta in a section stained by Levaditi's method, since Walter Schultze and others have pointed out the frequency with which nerve-endings and precipitates simulate the spirochæta when stained by this method.

According to present views, the dark field microscope holds the first place for the detection of the syphilitic organism. Against Igersheimer's finding, Clausen brings 14 cases of interstitial keratitis in which he excised pieces from the corneæ, and even with the dark field microscope was unable to find a single spirochæta.

It is claimed that experimental interstitial keratitis belongs also to the early stages of syphilis, and does not really represent the typical interstitial keratitis seen in humans. Furthermore, experimental interstitial keratitis may be produced without the actual introduction of living organisms.

A. Leber produced interstitial keratitis by the injection of dead trypanosomes, also by the injection of trypanosome toxin.

Samperi reports experimental interstitial keratitis after injection of diphtheria toxin.

Wessely, von Szily,* and others have succeeded in producing, as an anaphylactic phenomenon, an inflammation of the cornea which greatly resembled human interstitial keratitis.

* Von Szily: "Ueber die Bedeutung der Anaphylaxie in der Augenheilkunde," *Klin. Monatsb. f. Augenheilk.*, Feb., 1913.

A further proof, which seems also to strengthen the cause of the opponents of the direct infection theory, is the very general resistance of interstitial keratitis to salvarsan and mercurials.

The endothelial theory originally set forth by Leber seems disproved.

Von Michel believed this process to be due to a disease of the vascular network surrounding the cornea, which has been found microscopically, and states that these changes represent a peri- and endo-vasculitis of syphilitic origin. Clausen believes this theory has much to recommend it.

As a result of his researches, Elschnig comes to the conclusion that interstitial keratitis is a degenerative disease and follows a disturbance of nutrition, due to a change in the fluids which nourish the cornea. He assumes toxins circulating in the blood, which also invade the corneal lymph and exert a "nutritive irritation" on the fixed cells of the cornea as well as on the vascular network at the limbus.

Guillery, from his experiments on the effect of ferments on the eye, has constructed a hypothesis on the following lines: That each poison has a selective action for some tissue, and that the toxin of syphilis has this affinity for the cornea; that in hereditary syphilitic individuals, for some reason, be it through some cause in the general system or through a local cause in the cornea itself, such as a trauma, the vitality of the cornea is lowered, giving the toxin circulating in the blood its opportunity to act.

It is not beyond possibility that interstitial keratitis is an anaphylactic phenomenon.

Wessely injected one or two drops of sterile, inactive beef or horse serum into the corneal tissue. This was followed by little reaction, and all signs of the injection passed off after a few hours. Following this injection one of two things happened—either the eye did not react at all, or after a delay of twelve to fourteen days there came severe injection, fol-

lowed by a progressive opacity in the deeper layers of the cornea, sometimes with a deep vascularization. A further remarkable fact was noticed. At the time of the outbreak of this disease in the first eye, if a small quantity of serum was introduced into the cornea of the other eye, in twenty-four hours the characteristic interstitial inflammation developed, instead of in fourteen days, as in the first instance.

Von Szily and Arisawa repeated these experiments and enlarged them. The injection was made in the right eye. At the end of fourteen days, if the eye still remained quiet, a second injection was made in the same eye, which was followed in twenty-four hours by a severe interstitial keratitis with deep vessels, often circular pannus, hyperemia of the iris, and sometimes posterior synechia.

In a second series the first eye was injected, and at the end of fourteen days a second injection was given, this time 4 c.c. of serum being introduced intravenously. Following this injection there was immediate, very noticeable contraction of the pupil, which lasted several minutes. In the eye previously injected there developed an interstitial keratitis at the end of twenty-four hours, or if an interstitial keratitis had already developed, it became more severe. Naturally, the left eye, which had been untreated, remained normal.

We know that in congenital syphilis spirochætæ wander into the cornea, usually, however, without producing a noticeable reaction. Their presence, or the presence of a luetic toxin, would be sufficient to sensitize the tissue. Now let us suppose, as does Guillery, that during some period, usually in childhood, the general resistance becomes lowered, be it through poor hygienic surroundings or through some general infection, such as one of the exanthemata or tuberculosis or through a trauma, the latent syphilitic virus will again become active, and the eye previously sensitized may speedily react to the increased quantity of syphilitic ma-

terial in the circulation. Such an explanation has been suggested by Verhoeff* for phlyctenular disease.

In explaining interstitial keratitis, this is as far as we can go at present; but recent progress raises the hope that the problem is nearing its solution, and a solution is greatly to be desired, if only from the standpoint of treatment.

Treatment.—Interstitial keratitis is one of the most discouraging diseases which the ophthalmologist has to treat. Little benefit may usually be observed from the remedies employed, and when improvement occurs, it is so slight as to be almost imperceptible. The disease drags on for weeks and months, and, most discouraging of all, the second eye becomes involved in spite of everything that can be done to prevent it, and the final outcome, often in the material loss of vision, is most discouraging. Is it any wonder that we dread these cases in private practice, and that they excite less interest than they deserve at the hospital?

Long-continued observation has shown that this lesion on the average is extremely backward in responding to the usual antisyphilitic treatment. The use of mercury and iodid appears in the ordinary case to have but slight influence on the progress of the disease. The advent of salvarsan was hailed with great joy, and when the wonderful improvement in the general symptoms of syphilis and in the eye, especially in syphilitic iritis, was observed, it was hoped and expected the same would be the case in interstitial keratitis. Unfortunately, this has not been true, and, although a few observers have reported a marked improvement in certain cases, and though many have seen improvement in the subjective symptoms, yet, on the whole (and now a large number of cases are on record), the results are disappointing. Thus we must conclude that salvarsan has little local influence on interstitial keratitis.

* Verhoeff: "Some General Considerations Concerning Tuberculosis of the Eye," *Ophthal. Record*, Dec., 1908.

The failure of salvarsan to act has been explained in several different ways. Igersheimer, supposing that the spirochætæ lie latent in the cornea from fetal life on, believes that they are probably so changed by the unusual conditions there that they fail to react to the drug.

Others have suggested that, owing to the avascular structure of the cornea, salvarsan does not penetrate to a sufficient extent.

Löhlein has disproved this to a certain degree. Following a suitable intravenous dose of salvarsan in rabbits, he was able to show arsenic in the cornea two hours following the injection and lasting up to eighteen hours. After a subcutaneous injection of double the amount, it was found in the cornea thirty minutes later and up to eighteen days.

Hata and others have shown the favorable action of "606" in experimental corneal syphilis, and the fact that a local reaction is sometimes seen in the eye after injection is further proof that the drug reaches the cornea.

Löhlein suggests an explanation of the action of "606," first set forth by Uhlenhuth, Lesser, and others: that the virtue of salvarsan is not dependent on its direct ability to kill the spirochæta pallida, but on its organotropic power; that is, the stimulation of cell activity and especially the production of antibodies. On this basis "606" might reach the cornea, but not be able to exert its full effect, since the corneal tissue possesses but a small ability to produce antibodies.

On the assumption that not enough salvarsan reaches the cornea, Löhlein in two cases of interstitial keratitis made repeated subconjunctival injections of a dilute neutralized solution of salvarsan, about one centigram of the drug being introduced at each sitting. He was unable to observe the slightest effect.

Recent investigations on the so-called meta- or parasyphilitic affections may have a certain bearing here, as

many authorities have held interstitial keratitis to be of this nature. Evidence is now being brought forward to prove that some of these remote manifestations of syphilis bear a closer relation to the disease than had been previously thought.

We understand that Noguchi, in an investigation (not yet published in full) of 200 brains of general paretics, has found the spirochæta pallida in 48, and also in several tabetic cords. This work, confirmed, would seem to demolish at one blow the theory of meta- or para-syphilis.

Swift and Ellis,* also of the Rockefeller Institute, have devoted their attention to tabes. They point out the fact that the majority of cases show evidence of a localized meningitis around the roots of the cranial and spinal nerves. Salvarsan, acting through the blood-stream; works at a disadvantage on these lesions, since the main seat of the disease is surrounded only by lymph into which the drug is secreted little if at all. They point to the work of various men, especially Flexner,† showing that in order to obtain results from treatment of meningitis, the agent must be injected directly into the subarachnoid space.

There is evidence to show that the blood-serum of cases treated with salvarsan has curative powers, and, acting on this fact, Swift and Ellis have injected salvarsanized serum into the spinal canal of tabetics, with a considerable degree of success, as indicated by the subjective improvement, by the disappearance or decrease in intensity of the Wassermann reaction given by the spinal fluid, by the marked decrease in the lymphocytosis, and by the considerable decrease in the amount of globulin present.

Their work is being taken up elsewhere, and in a verbal communication, Dr. J. B. Ayer, of Boston, tells me that he

* Swift and Ellis: "The Direct Treatment of Syphilitic Diseases of the Central Nervous System," *New York Medical Journal*, July 13, 1912.

† Flexner: Cited by Swift and Ellis.

has had similar success in a small series of cases. It is too early, as yet, to judge of the ultimate value of the method.

In the hope that salvarsanized serum might be of benefit locally in interstitial keratitis of luetic origin, the writers have injected six cases during the past winter. The technic in the main was that laid down by Swift and Ellis. The patient received in the morning a full dose of neosalvarsan intravenously. After an hour blood was withdrawn from the patient into tubes, which were placed in the ice-box over night to allow the serum to separate. The serum was then drawn off and heated at 56° C. for one-half hour.

In our first case, it was then diluted to 40 per cent. with normal saline solution, and 0.4 c.c. was injected subconjunctivally close to the limbus bordering on that part of the cornea which showed the most active process. As the reaction from the injection in this case was nil, the serum from the next three was used in full strength, and 0.4 c.c., 0.6 c.c. and 0.45 c.c., respectively, were injected. To the serum of case 5, 0.075 gm. of neosalvarsan was added, and 0.6 c.c. was injected. It should be said that cases 1, 2, and 3 represented recurrent attacks of the disease. Case 6 differed in being an adult with an interstitial keratitis following an acquired syphilis. He received 0.7 c.c. subconjunctivally.

For the benefit of future investigators it has seemed worth while to report these cases, although in none could the result be regarded as remarkable. There was no reaction from the injection, and in all the subjective symptoms seemed to improve, but it cannot be said with truth that the eyes have cleared any more rapidly as a result of the treatment. The greatest improvement was noted in the case of acquired syphilis, but here it might well have been due to the intravenous injection of salvarsan alone.

In spite, however, of the apparently discouraging results of antisyphilitic treatment, it is the duty of the ophthalmologist in all cases to do more than order local measures for

the eye. He should see that each of these individuals is thoroughly treated for his general syphilis, of which the ocular process is but a part.

Just what method should be employed rests on individual preference and on the nature of the manifestations. One of the most effective and simplest methods is the administration of gray powder (hydrarg. cum creta) in doses of from gr. ½ to gr. 3, three times a day, according to the age. This drug is well borne and easily administered, and may be taken for years without the production of untoward symptoms. In some cases it is wise to add a few injections of salvarsan or neosalvarsan, or to give mercury by intramuscular injection, or from time to time to add the iodids in suitable doses. But whatever method is chosen, continuity of treatment over years is of the greatest importance.

The iodids are of value in some cases for their tonic effect and for their apparent value in assisting the action of mercury, but it cannot be too strongly stated that in the light of present knowledge the treatment of syphilis, be it acquired or hereditary, is totally ineffectual with the iodids alone. Although the improvement in interstitial keratitis from the use of general antisyphilitic treatment appears in many cases to be small or even lacking, the writers are firmly of the opinion that the average case reaches its termination in a somewhat shorter period of time than when antisyphilitic treatment is omitted.*

There are other benefits, too, which result: improvement in general health is usually marked; other late lesions of the disease, such as those occurring in the brain and in the bones and joints, will largely be prevented; and recurrences in the eye, which are not by any means uncommon, will much less frequently occur.

It has been our experience in questioning a large number

* It goes without saying that hygienic and tonic measures directed toward improvement of the general health are of the greatest importance.

of cases to find that very few of them have followed out their treatment for any considerable length of time. In part, this is the fault of the specialist, who, when the diseased organ which he is treating clears up, does not insist on the necessity for further general measures. Often it is the fault of the parents and those in charge at home. The main fault, however, lies in our system.

These cases come to our clinics for eye treatment, and we forget that the ocular process is but a single manifestation of a general disease. We would not think of undertaking the general treatment of a case of albuminuric retinitis occurring in pregnancy; and it is little more logical for us to undertake the general treatment of syphilis since, in the nature of things, most of us can be but poorly equipped for the task. Our earnest plea is that all these cases when seen in the clinic should be referred to the expert on syphilis, and that when possible general treatment should be carried out by him.

Patients will not keep on going to the eye hospital after the ocular process has subsided, and in truth it is illogical to expect them to do so. Parents must be educated to the point of realizing that their children are suffering from a general disease of serious nature which requires years of treatment. Such education cannot be carried out if their attention is simply directed to the process in the eye alone.

Furthermore, we have come to realize the impossibility of handling these cases expeditiously and efficiently without the help of the social service worker. As in certain other chronic and recurrent eye diseases, it is most important to give frequent and continuous supervision and to visit these patients in their homes. This the doctor cannot do. Interstitial keratitis patients, like those afflicted with tuberculosis of the eye and like the cases of phlyctenular disease, are well handled by the group or class method, and this, to a

certain extent, has been instituted and successfully carried out in the Massachusetts Charitable Eye and Ear Infirmary.

During the past eighteen months many cases of interstitial keratitis have been placed under the supervision of a social worker, to whom they report on reaching the hospital. After receiving appropriate local treatment from the ophthalmologist on duty, they are conducted to the Boston dispensary, where they are taken in charge by the dermatological and syphilis clinic, presided over by Dr. Abner Post, and ably seconded by Dr. C. Morton Smith. The general diagnosis is made and treatment instituted. The patient is seen as often as necessary, and, when the ocular process is healed, the patient is not turned adrift, but continues under the best of general supervision and treatment.

The results of this combined treatment have been eminently satisfactory. It has seemed that our patients have shown more rapid improvement in the ocular process and especially in their general condition; and the patients themselves have greeted the additional care bestowed on them with enthusiasm and have been most faithful in their attendance. Thus systematic and continuous treatment is given to each case unless actually refused, and this has occurred in but one instance.

There is one other important feature to which we would like to allude. Syphilitic interstitial keratitis furnishes a great opportunity to the physician for public service. Each case represents an infected family. We should not be satisfied in providing treatment for the one member who presents himself at the hospital. We should go after that family, and we will frequently unearth other cases of hereditary syphilis, besides acquired syphilis of the father or mother. Many brothers, sisters, and parents of our eye cases have been taken to Dr. Post and Dr. Smith for diagnosis and treatment, and it is sufficiently obvious how much good has thereby been accomplished.

The number of our patients and of the families investigated is growing apace, and we hope, in the not far distant future, with the co-operation of Drs. Post and Smith, to whom we owe our sincere thanks for the interest and time they have devoted to this work, to publish a more detailed account of the exact results accomplished by the methods herein described.

Our thanks are due to Drs. E. E. Jack, A. Quackenboss, and A. G. Morse for permission to administer salvarsanized serum to the six cases described in this paper.

LITERATURE.

All references given in this paper are to be found in the bibliography attached to Clausen's admirable paper, with the exception of those of Verhoeff, von Szily, and Swift and Ellis.

DISCUSSION.

DR. EMIL GRUENING, New York: One remark of Dr. Derby's was that the results of treatment of keratitis parenchymatosa are not satisfactory. To this statement I would take exception. In my experience, almost all cases recover without the use of salvarsan. As a matter of course, it is important to treat each case locally as well as generally. Many cases are complicated with iritis. These should be carefully watched by the physician, and the pupil kept dilated. Only very rarely does a case that is kept in the hospital under constant observation fail to make a good recovery. The remaining corneal opacities are not often dense. In very young children the disease is seldom observed.

We know that most, perhaps all, cases of parenchymatous keratitis are of syphilitic origin. My treatment consisted of mercurial inunctions, internal administration of iodid of potassium, and, locally, warm applications and instillations of atropin.

This keratitis occurs generally at puberty, but I have seen it at thirty years of age. I had under my observation three generations of one family—a woman whom I treated thirty years ago, when she was about thirty; her son, whom I treated at the age of twenty-five; and his child, when aged

thirteen. They all had keratitis parenchymatosa. Though this family was a large one, only one member was affected in each generation.

I heartily indorse Dr. Derby's recommendation to continue the mercurial treatment for years after the disappearance of the corneal trouble. This is in accord with the present view of prevention of metasyphilitic complications.

DR. H. D. BRUNS, New Orleans: It seems to me that we ought to take part in these debates when they touch on subjects in which we have an especially large experience. As the negro, with us, is pretty nearly always syphilitic, and his offspring have interstitial keratitis in a wholesale way, I see it incessantly and everlastingly. I agree fully with what Dr. Gruening has said. If not utterly neglected, it is one of the most benign of serious diseases. I never saw a case that did not get well. It is a dangerous thing to prophesy, but I believe the view that regards it as secondary to some uveal affection is bound to prevail. The younger Galezowski summarized lately the history of a number of cases (*Recueil d'Ophtalmologie*) of interstitial keratitis and reports lesions of the choroid in a large percentage. In vaunting any one treatment in comparison to others in such a disease we trespass on dangerous ground. The difficulty of estimating the duration of the disease is great. I have seen cases get well in a few weeks. Others will drag along for months or even years. It is only by taking a vast number of cases treated in one way, and getting some idea of their average duration, then comparing large series of cases treated in various other ways, that we can arrive at a certain conclusion as to whether our treatment is doing good or not. I know too well how fallacious our general impressions are. I believe we should employ, and do so with advantage, a vigorous antisyphilitic treatment, the sheet-anchor being inunctions, if possible with Turkish baths, and using the mercury to the point of toleration. I always use it in the form of Arlt's salve. This old formula seems to be unknown to some members of the Society. It consists in rubbing up a dram of belladonna extract with every ounce of mercury. The belladonna has a restraining influence on the poisonous effect of the drug. You can use mercury longer and more vigorously than if you use it without

the extract of belladonna. These cases certainly seem to me to be shortened in their duration when treated in this way. Locally, I know of nothing but to keep the pupil dilated. Here we are against a dangerous proposition, because the cornea is softened by the disease. The tension is usually elevated at some time during the attack. If we use the atropin excessively, we will have bulging of the cornea. The atropin must be used to keep the pupil dilated, to break up posterior synechiæ, and abate iritis by squeezing blood out of the iris, but it must be used carefully and cautiously. As to salvarsan, there can be no doubt that its immediate injection is agreeable to the patient. The uveal symptoms, the photophobia, the iritic injection, and the exudates are favorably influenced by salvarsan. But I do not believe the clearing of the cornea is influenced at all.

DR. W. B. MARPLE, New York: I would like to ask Dr. Derby, in his use of salvarsan, how frequently he employs it. Of course, we all know that interstitial keratitis gets well, but the question is as to whether it gets well any quicker by the use of salvarsan than by the old methods of treatment. Up to about a year ago I had the impression that salvarsan was not of any special therapeutic advantage, but I used it only once in each case. I had the pleasure, last summer at Liverpool, at the session of the British Medical Association, of meeting Dr. Igersheimer, who advises the use of salvarsan and repeating the dose once or twice. So this year, in the cases of interstitial keratitis which have come under my observation, I have given one injection, and repeated it in two weeks, and possibly in two weeks have given a third injection, even if the Wassermann was negative. Usually, however, after the injection of salvarsan, the Wassermann is still positive at the end of two weeks. I am quite sure the results are very much better when the remedy is thus employed than used as I did a year ago; also that the progress of the disease toward recovery is much more rapid than by any of the older methods of treatment.

DR. WALTER R. PARKER, Detroit: I have had opportunity to use salvarsan in a limited number of cases of interstitial keratitis in which I was able to have frequent Wassermann

tests made, and to observe the course of the disease throughout. The salvarsan was given intravenously, always repeated once, and several times if the Wassermann test was not negative, one case receiving five doses. In every case in which the Wassermann was negative, after the first or second dose the relief in the subjective symptom was most remarkable, but in two cases in which the Wassermann remained negative the relief of symptoms was much less marked. Although the inflammatory symptoms clear up to a marked degree and the comfort of the patient is greatly improved in the course of twenty-four hours, I have not seen any greater improvement in the corneal infiltration than could be expected under the inunction treatment alone. In one case, in which the second eye became involved while the patient was under treatment, the course of the disease was much milder than in the eye first involved. Whether this was a result of the salvarsan or the inunctions of mercury I was unable to say. In every instance the combined treatment was used. While the effect on the cornea is disappointing, I believe the use of salvarsan is indicated in these cases for the relief of the inflammatory symptoms. It is difficult to imagine a more marked clinical change than is seen when the Wassermann is negative after the first or second injection of salvarsan. I agree with Dr. Derby when he says these cases should be treated for syphilis and not for one of the symptoms of the general infection.

DR. R. L. RANDOLPH, Baltimore: I have in mind four cases of interstitial keratitis in which salvarsan was used. In two of the cases the patients were boys under fourteen years of age, and the keratitis was of the hereditary type. Salvarsan was used, without the slightest effect, as far as I could see, and it was finally abandoned. It may be said that mercury inunctions and iodid of potassium cleared up the corneæ within eighteen months. In the other cases my patients were young men under thirty, medical students, who consulted me about the same time last autumn and who gave a clear history of lues. They afforded beautiful examples of interstitial keratitis, monocular in both cases. The rapidity with which the corneæ cleared up as the result, apparently, of salvarsan was in striking contrast to the be-

havior of the two children who were treated similarly for the hereditary type of the disease. The corneæ were practically clear in five months, the vision in one case being $\frac{20}{20}$. The improvement was quite noticeable after one month's treatment. It must be said, however, that iodid of potassium was given and injections of salicylate of mercury were employed throughout the treatment. I want to say here that interstitial keratitis due to acquired lues is in my experience rare, while I see the hereditary form not infrequently. While I regard the prognosis in the latter variety for ultimate recovery of sight as very good, I seldom see a clear cornea under a year or more. The impression I got from the use of salvarsan in treating the hereditary form of the disease was that it is probably of no value, while in the interstitial keratitis of acquired lues it seems of undoubted value. I do not believe that the spirochetæ are found in a cornea which is the seat of hereditary interstitial keratitis, and Clausen and others take a similar view, while it is not unlikely that we do find them in this part of the eye in the acquired form of the disease.

Dr. C. H. Beard, Chicago: While it is true that this corneal process wears itself out in time, the most desirable thing is to see that it subsides as quickly as possible, because the longer it is extended, the greater likelihood of remaining permanent and extensive corneal opacity and consequent impairment of vision, and that, of course, is the most important thing for the patient. There are two points in the treatment which were taught to me years ago by Dr. Agnew, of New York, that I would like to mention: one is the objection to the prolonged use of atropin, keeping the pupil widely dilated, because that interferes, as you know, more or less with the quickness, or in another sense the activity, of the lymphatic and venous circulation around the root of the iris, and this, in turn, leads to hypertension of the globe. It was Dr. Agnew's custom to alternate the use of atropin with eserin, or some miotic, under these conditions, so as to quicken the circulation in the anterior half of the eye. The second point is to relieve as quickly as possible the excessive blepharospasm. We know that this has a paralyzing or a squeezing-out effect upon the cornea. To get it quickly relieved is very

desirable. To leave these children at their homes to be looked after by a visiting nurse or a missionary of some sort is not sufficient, for the parents are prone to be lax in their discipline, and allow the child to do the very things that prolong the disease. It is desirable to get them into a well-ordered hospital, and the blepharospasm relieved as quickly as possible. If it cannot be done by conservative measures, a canthotomy is indicated.

DR. G. E. DE SCHWEINITZ, Philadelphia: I would like to say a word in regard to salvarsan in interstitial keratitis and the method we pursue at the University Hospital. The value accorded to therapeutic measures by various observers is always interesting. Thus, recently, I read in a foreign ophthalmologic journal that mercury had never accomplished any good in interstitial keratitis except possibly the prevention of deafness. This statement is in entire discord with my own experience, and I fancy with the experience of most of us here today. So, too, I do not share the pessimism in regard to salvarsan in the treatment of this disease; at least I find it valuable if used in the manner presently to be described. In a series of patients recently admitted to my wards, all with advanced syphilitic interstitial keratitis, the patients varying in age from twenty years to seven years, and all of whom had for a long period received at other hands careful mercurial treatment, the rapidity with which the disease subsided after the use of salvarsan was most gratifying. The method was to give salvarsan in full dose, at intervals of three to four weeks, and during the intervals to employ mercury and iodids in the usual manner. The first and promptest relief was seen in the subsidence of the pain and cyclitis, as has often been noted. But in less than five months in two of these patients the vision had risen from counting fingers to $\frac{6}{9}$, and in one of them, a child of seven, from practical blindness to a vision of about $\frac{6}{60}$. It seems to me that the combined action of mercury and iodid of potassium with the salvarsan produced a result which I have never before seen exceeded in rapidity of development. It is very difficult to state in words how long one must wait for recovery, but the interesting point is that these patients had been treated for a long period of time in the usual man-

ner unsuccessfully, while the combination of salvarsan and the alteratives named gave the result described.

DR. CHARLES W. KOLLOCK, Charleston, S. C.: My experience is the same as that of Dr. Bruns as to syphilis in the negro and the prevalence of interstitial keratitis among them. Also, that most cases of this disease recover, and a fair number without any treatment except good food and hygienic surroundings. My treatment is usually by mercurial inunction, aided by iodid of potassium during the convalescent stage. Where the cornea remains hazy, iodid of potassium may be of considerable assistance in helping to clear it. In many cases a careful examination of the cornea will show that the hazy areas remain for years and perhaps never entirely disappear. I remember one case of interstitial keratitis which occurred in a white boy whose father was syphilitic and the mother healthy. He had several manifestations of inherited syphilis, among which were typical Hutchinson teeth. A brother was born about two years later who not only resembled the mother, but has never shown any sign of the disease nor has the mother. Both boys are now men, and the elder was cured, and at last accounts was a healthy man. As to the bulging of the cornea during the inflammation, it undoubtedly occurs to such an extent as to cause an eye that was normal before to become myopic, but in my experience it has usually returned to its normal shape, and even where glasses were prescribed and worn for a time with comfort, they were eventually discarded. I do not think that conical cornea is a very common result.

DR. JOHN E. WEEKS, New York: Dr. Derby's paper has interested me very much. The experiments that have been made in regard to sensitizing the cornea are suggestive. We know very well that we can sensitize a guinea-pig against the blood of a sheep by making one injection; the second injection will prove fatal if properly conducted. It seems to me that the explanation given, that the cornea is sensitized in cases of inherited syphilis, is a very probable one. The development of interstitial keratitis a number of years after the child has been infected, accompanying depression in general health, is an expression of reinoculation through the system—an autoinoculation of the cornea. In regard to the

presence of the spirochætæ, it is very probable that the effect of salvarsan on the cornea depends very largely on the number of the spirochætæ in the cornea. We know, those of us at least who have had experience, that interstitial keratitis, as a rule, is affected very little by salvarsan. It is affected somewhat, however, and most markedly, in the acute cases. Apparently the cases that are most acute have a greater content of spirochætæ. In cases of interstitial keratitis as a result of *acquired syphilis*, the effect of salvarsan is often quite remarkable. It has occurred to me that the number of spirochætæ in interstitial keratitis due to acquired syphilis is greater than in the inherited form, hence the more marked effect of salvarsan. The use of neosalvarsan is falling into disrepute in my experience. I have referred a number of cases to Dr. Fordyce, who, after the extensive use of neosalvarsan, is gradually coming back to the use of the older preparation. In regard to the effect of interstitial keratitis on the eye, what Dr. Gruening says is true. There are a few cases, however, in which opacity of the cornea has reduced vision to perception of light, and some cases that have been followed by ectasia of the cornea and cataract. Dr. Callan, who is here, remembers the case of a young man we saw some years ago. He had double cataract, which I removed. I found that the corneæ were very thin. They measured, approximately, 13 mm. in diameter. This is one of the cases in which the effect of interstitial keratitis was extremely unfortunate until the cataracts were removed.

DR. PETER A. CALLAN, New York: It has been my misfortune to see one case of total blindness resulting from interstitial keratitis. Various writers of our text-books go on to state that suppuration never occurs in the parenchyma; it does—I have seen cases: two in one family, a brother and sister.

DR. S. LEWIS ZIEGLER, Philadelphia: There is no doubt that certain selected cases of interstitial keratitis improve more rapidly under the use of salvarsan than by the use of other methods. But, on the other hand, it is not necessary, while injecting salvarsan, to stop all other specific treatment. In the cases that I have observed the salvarsan produced a rapid improvement and a rapid reduction of the Wassermann

reaction—in one case from +4 to +1, doubtful, after two injections. The intravenous injections produced better results than those made intramuscularly. One case, however, was not successful, and the treatment by mercurials was equally unsuccessful, but the use of injections of tuberculin produced a moderate improvement. This was a case that had been under treatment for nine months before I saw the patient, and there was practically no result, so far as vision was concerned, although the eye became quiet. The lesions seemed to be located more especially in the uveal tract, and finally produced a cataractous condition for which I expect to operate later.

I think there is no doubt that we can get a more prompt result through the use of salvarsan, and thus avert impending danger where the lesion is destructive. It may be that the more frequent injections which Ehrlich recommends—once a week—may yield better results.

DR. ROBERT SATTLER, Cincinnati: The discussion has certainly brought out what a larger experience with salvarsan, and mine in particular, upholds, that both methods of treatment are almost uniformly successful. I want only to express my appreciation of the presentation of the scientific side of this important subject, the demonstration of the presence of the spirochætæ in the cornea.

DR. HERBERT HARLAN, Baltimore: I would like to say a word in regard to the curiously beneficial effect from an intercurrent attack of measles in interstitial keratitis. I reported a case in Knapp's *Archives* some years ago. It was of a cure, in two or three days, of a severe case which under ordinary treatment would certainly have taken many months. I have had perhaps 8 or 10 of these cases since. Dr. Driver, of Norfolk, told me of 3 cases occurring in his practice. As a remedy it cannot often be used, because most children have already had measles. I have on two occasions, however, found typical cases of interstitial keratitis in children from out of the city who have not had measles. The children were exposed to measles, which they contracted promptly, and when seen a few weeks later the keratitis was practically well.

Whether anything could be done by a measles serum I am

unable to say, but in every case where measles has occurred in a case of interstitial keratitis the keratitis has been wonderfully benefited. I would like the Society to bear in mind this curious effect of measles in the disease under discussion.

DR. W. E. LAMBERT, New York: I want simply to emphasize the importance of continuing the mercurial treatment in conjunction with salvarsan in these cases. In this connection I should like to mention briefly a case of keratitis in a medical student that recently came under my observation. Although it was supposed to be a syphilitic lesion, the Wassermann reaction was negative. The case was treated with atropin and hot applications and very quickly recovered. Some months afterward the young man returned with a history of a mild keratitis in the other eye, which he had treated with argyrol and hot applications, but no atropin; the vision was reduced to $\frac{20}{100}$, which could not be accounted for by the condition of the cornea. On examination I found a deep glaucomatous excavation, contracted field, and tension of about 50 mm. The vision of the other eye was $\frac{20}{30}$, the field was slightly contracted, and there was a slight cupping of the disc. On further examination there was found an anterior choroiditis which seemed to give unmistakable evidence of a syphilitic origin. Another Wassermann was taken, with a positive reaction. The patient was put on active anti-syphilitic treatment, salvarsan, mercury, etc., with local applications of hot water and eserin. At the time there was no marked inflammatory disturbance. About a week later the tension increased, and a double iridectomy was performed. This controlled the glaucoma, but the corneal process became more aggravated, and the patient has had a severe attack of typical interstitial keratitis. Dr. Risley, who saw the patient, suggested a tubercular origin, but the tuberculin tests were negative. He is improving somewhat, and I have hopes of some vision; it is now $\frac{6}{200}$ in one eye.

DR. A. N. ALLING, New Haven, Conn.: I desire to mention one point regarding the favorable prognosis referred to by Dr. Gruening, that is, it is known that these cases will once in a while develop glaucoma. I have in mind a case

where both eyes were lost through secondary glaucoma in spite of the best care. In regard to treatment, my experience has been that the best results come from giving salvarsan and a course of mercurial treatment, and then sending the patients into the country, where they get fresh air, milk, and proper hygienic surroundings. I believe, if you can see the patient occasionally to ascertain whether the pupil is properly dilated, that you will get the best result from this form of treatment.

DR. GEORGE S. DERBY, Boston: Of course, the local treatment of interstitial keratitis is extremely important. We want to emphasize, however, that this disease is an evidence of general syphilis, and, even though by the use of salvarsan, mercury, and the iodids we do not get a much more favorable outcome of the local disease, we may prevent other lesions of hereditary syphilis, such as the bone lesions, the deafness, and even the general degeneration which may come on later. Not infrequently they get recurrences in the eye. We believe in long-continued treatment with mercury and iodid, and we wish to emphasize the fact that these cases should not be sent away without general treatment and should not be put on iodid alone, for in the light of present knowledge, it is universally recognized that it is not possible to treat syphilis successfully in this way.

OPHTHALMIA ARTEFACTA.

HENRY DICKSON BRUNS, M.D.,
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The chapter on self-inflicted injuries of the eye is a long and interesting one. Instances of persons, insane, highly hysterical, or under religious obsession tearing or gouging out an eye are well known;* so, too, are auto-mutilations

* Ophth. Year Book, vol. viii, 1911, p. 292, and Henderson, *American Journal of Ophth.*, October, 1908.

and burns of the eye with a wide variety of instruments and substances by soldiers wishing to escape military duty or to increase their pensions and by hysterical subjects. These have been known to introduce into their eyes bodies varying from bits of glass and pieces of cloth and matches to spiders, ants, and other small insects or the secretions of these creatures.*

Henderson (*loc. cit.*) reports the case of a young Sister of Charity who repeatedly burned the skin of the lid, presumably with carbolic acid, and finally the palpebral and bulbar conjunctiva so severely that symblepharon must ensue. His case more closely resembles the one I am about to describe than any I have been able to find. But in Henderson's patient only the lower lid and its conjunctiva and the adjacent conjunctiva of the ball of one eye were attacked, as is usually the case in ophthalmia artefacta.

While these were the tissues burned in the case here reported, both eyes were attacked, the injuries and their consequences were much more extensive, they recurred with suddenness over a period of many months, and the clear definition, depth, and deep black color of the lesions were unlike anything known to the several observers who saw the patient.

L. I., a white girl, seventeen years of age, entered the eye clinic of the Eye, Ear, Nose, and Throat Hospital on May 13, 1908. She was of fair size and build with brown hair and gray eyes. Pasty and puffy of face, she suggested at once the clinical type we call scrofulous. Her eyes, she said, had been sore, off and on, ever since she could remember. V., R. E. = $\frac{20}{70}$; L. E. = $\frac{20}{50}$. Examination revealed a common blepharo-conjunctivitis. Applications of all the usual remedies were made to the conjunctiva, but without apparent benefit, until June 6, 1908. On that day

* Mackenzie: Practical Treatise on Diseases of the Eye with Notes by Addinell Hewson, Phila., Blanchard & Lea, 1855, p. 258, *et seq.* Ophth. Year Book, 1905, p. 197; 1908, p. 286; 1909, p. 299, and 1911, p. 292.

a small superficial ulcer, with no special characteristics, appeared on the skin of the upper and lower lids of the left eye, and on the following day the ulcer had increased in size. A smear showed nothing definite, and the ulcer was touched with a fifty grain to the ounce solution of silver nitrate, the patient complaining of great pain. The ulcer healed slowly. Under atropin, a simple hyperopia of 1.50 D. was found. Although applications of silver nitrate, zinc sulphate, borax and boracic washes, and iodosyl salve were tried one after the other, the conjunctival hyperemia persisted until July 6, 1908, when shallow ulcers of the conjunctiva of the lower cul-de-sacs of both eyes were noticed, and at the same time the patient again complained bitterly of pain. Dr. Cazenavette, the neurologist, and Dr. Lynch, our colleague of the Ear, Nose, and Throat Department, were called in consultation. Dr. Cazenavette found a neurasthenic condition only; Dr. Lynch, nothing, but on his suggestion we pushed "the mixed treatment."

On August 24, 1908, the ulcer in the right eye, which had invaded the bulbar conjunctiva, seemed to expose the sclera and looked very angry. An iodoform salve was applied, and later it was touched with carbolic acid. We admitted the patient to the house on September 9th, as the ulcer in the right eye was very deep, showing in its depths a black spot which was taken to be the exposed choroid. There was abundant mucopurulent discharge from this eye; smaller ulcers in the cul-de-sac of the left eye. The pain, of which the patient had complained constantly, was less severe. Dr. E. A. Robin, the first assistant surgeon at this time in charge of the clinic, ordered irrigation every two hours with a 1 to 5000 potassium permanganate solution, and the ulcer was touched with silver nitrate (gr. xx to ℥j).

The condition of the eye improved steadily until September 18th, when it suddenly became much worse; the ulcers increased in size and looked exactly as though suffused with ink, the central deepest part being intensely black. This was then perceived to be due to tissue necrosis (?) and not to exposure of the choroid.

From October 1st to November 25th we tried the Roentgen rays, but without effect.

On November 25th the left eye was almost normal, but

in the right eye a black, necrotic area, averaging one-fourth of an inch in width, extended from the lower corneal margin down into the cul-de-sac and up through the palpebral conjunctiva to the free edge of the lower lid. Smears and cultures from the ulcers were examined by competent bacteriologists and were thought at first to show evidences of diphtheria; but on further study other smears, cultures, and bits of tissue were pronounced negative. In the interval of doubt 4000 units of diphtheria antitoxin were injected, but without perceptible result. On December 15th, there were large black eschars in both eyes and the hyperemia was severe; and on December 17th a new circular ulcer, one-fourth of an inch in diameter, surrounded by a narrow red zone, appeared in the lower cul-de-sac of the right eye. At about this time we were honored by a visit from Dr. Calmette, who was good enough to apply his tuberculin test. After due observation he expressed his conviction that the patient was not tuberculous. Indeed, it may be here stated that the patient never presented any symptoms pointing to a disturbance of her general health.

From December 17th the eyes improved and injection and pain had almost disappeared, when, on January 22, 1909, the girl complained that the left eye had pained all night. The lids of this eye were found to be chemotic, there were profuse lacrimation and conjunctival and ciliary injection. On the lower lid was a white slough, from one-eighth to one-fourth of an inch wide, extending in an almost straight line from the skin edge across the lower cul-de-sac to the corneal margin. The right eye was slightly injected and there was almost total inferior symblepharon. New cultures were made at this time, but were all reported negative. January 29th the injection was severe and the slough in the left eye was still white; there was no secretion, but a thin membrane was adherent to the ulcerated surface. Again smears, cultures, and bits of tissue were examined in vain. Under borax and argyrol solutions the case dragged along, an extensive symblepharon being established in each eye.

On July 8, 1909, I corrected the symblepharon in the right eye; dividing it, grafting in a piece of conjunctiva taken from an eye enucleated from a patient at the same time, and

doing a Kuhnt-Szymanowski operation to shorten the lower lid. July 12th the eye was examined and found to be doing well. On July 17th the last stitch was removed; the graft had taken and the operation seemed to be successful. On September 2d I did Arlt's operation for correction of symblepharon on the left eye, the condition not being as bad as it had been in the right eye. Both operations were done under instillations of 4 per cent. cocain solution and injections of the "10–10–20" solution (cocain hydrochlor., 4 per cent., 10 minims; adrenalin chlor., 1 to 1000, 10 minims; normal salt solution, 20 minims), which we have used in nearly all of our operative work since its introduction by Dr. E. A. Robin many years ago. September 10th the right eye was in good condition; the left eye doing well, but with some slight tendency to the formation of new adhesions.

On October 12th, after an absence of more than a month, the patient returned with symblepharon re-established in each eye, that in the right eye being more extensive. Dr. Robin, who was in charge of the clinic, felt sure, considering the condition of the eyes at the time the patient quit the clinic and the appearance on her return, that the results of the operation must have been destroyed by recurrence of sloughing of the conjunctiva during her absence.

On October 14th, however, Dr. Robin operated upon the right eye by a combination of the Arlt method with the formation of sliding flaps from the bulbar conjunctiva. The left eye was operated upon in the same way on November 11th. The anesthesia was produced by instillations and by injections of the "10–10–20" solution. The dressings were not removed for two days and the sutures for five days. The wounds were covered with a boric-acid ointment, and a lid retractor was frequently passed into the lower cul-de-sac to break up adhesions. November 23d both eyes looked quiet and seemed restored to a fair semblance of their normal state. With a sigh of relief, I expressed the opinion that the case seemed conquered at last!

November 24th, the very next day, the patient returned, presenting in the right eye a black slough of the conjunctiva, running as before across the cul-de-sac upon the bulbar conjunctiva up to within 4 mm. of the cornea. November 25th a third pathologist began a study of smears and cul-

tures. The skin of the right lower lid presented a superficial linear ulceration, about one-sixth of an inch from the free edge, and extending from its center to the inner canthus. There were three similar small spots on the upper lid. November 27th, the free edge of the lower lid of the right eye for about its outer half and for a width of about one-eighth of an inch was dead white and seemed about to slough over an extent corresponding to the conjunctival ulcer. November 29th the dead-white area on the lid had assumed a normal color and the ulcerated area was smaller. The smears and the cultures taken on November 25th contained only staphylococci aureus and xerosis bacilli.

On December 10th the right eye had steadily grown better and better under a simple borax-boracic acid wash, but with the formation of a new symblepharon.

On January 5, 1910, our note reads: Yesterday the eye was perfectly quiet and looking well; today there are large black sloughs on the upper and lower lids and on the conjunctiva. July 28, 1910, the patient said that, for the first time, she had one spot on her chest and eight on other parts of her body, like those she used to have in the eyes, but much larger.

She was thereupon put in charge of Dr. H. E. Menage, one of our consulting dermatologists, who placed her in his ward in the Charity Hospital. Dr. Menage showed the patient at a meeting of the Orleans Parish Medical Society on September 26, 1910. His paper, read on that occasion, together with photographs of the spots upon the body, were published in the *New Orleans Medical and Surgical Journal* of December, 1910.

When first seen by him in November, 1909, there had appeared, twenty-four hours before, lesions of the skin above and below the right knee. These consisted of large, deeply seated, irregularly shaped areas of coal-black, hard, gangrenous skin, surrounded by little or no inflammation. The outline, although irregular, was clean-cut and appeared to have been stamped. There were no especial subjective symptoms, no febrile reaction, and no general disturbances of any kind. The patches measured in size, irregularly, from a split-pea to one two and one-half by two inches. In the course of time the sloughs separated, leaving clean, deep-seated granu-

lating ulcers, which appeared quite healthy. Within a short time, probably two weeks, after the first series, appeared another on the left leg, in about the same relative location and having the same characteristics, except in configuration. For fully a year after this date new lesions developed more or less constantly on almost all accessible parts of the body, none, however, quite as severe as in the first and second outbreaks.

From a critical analysis of the case Dr. Menage placed it in the category of the so-called hysterical gangrene, spontaneous gangrene of the skin, disseminated gangrene of the skin, and dermatitis factitia or artefacta. The diagnosis was hysterical gangrene, but of the self-inflicted type, as differentiated from the spontaneous class. Although not able to say how and with what the patient caused these lesions, or whether the injury was caused by premeditation or unconsciously during a period of somnambulistic or subconscious personality, he believed that the study of other cases would bear him out in the theory of this one.

The last state of L. I., as we saw her on February 13, 1911, was deplorable. She was lame, thin, pallid, feeble, and was said to be suffering from pulmonary tuberculosis, and to have had several hemorrhages from the lungs. This was the first time during our observation of the case that any general symptoms were manifested. The eyes showed no active process of disease, but there were multiple symblephara and trichiasis. The corneæ had suffered and were marked by nubeculæ and leukomata. It is needless to say that vision was impaired. When last taken it was found to be in the R. E. light perception, and in the L. E. finger counting at 8 feet.

Although it seems incredible that any one would slowly destroy both eyes, reducing herself almost to blindness, while month by month the gradually growing calamity of her act might be perceived and appreciated; that she should submit herself to four trying, if not painful, operations and the tedium of recovery, and then lay waste her own comfort; yet, in spite of this incredibility, I see nowhere to turn from the conclusion of my colleague, Dr. Menage, that, as the

skin lesions must have been self-inflicted, dermatitis factitia, so, by the same reasoning, the eye condition must be called ophthalmia artefacta.

By what means these deep black sloughs of the conjunctiva were produced I am at a loss to understand. Mackenzie seems to have had a large experience with burns of the conjunctiva with a variety of chemicals, but he nowhere speaks of the resulting slough as black. The burns with nitric and with hydrochloric acid I have seen showed traces of a yellow discoloration at the edges. Once narrow white ulcerations upon the skin of the eyelid of our patient suggested the action of carbolic acid, but I cannot believe this substance could produce these deep black necrotic areas. Such lesions lead us at once to think of sulphuric acid, but Mackenzie says specifically that the sloughs produced by its action are white (*loc. cit.*, p. 260). I cannot think that these appearances could be caused by silver nitrate in any form without the production in other parts of the conjunctiva of the familiar argyrosis. It is to be noted that even when the patient was confined in the wards of a hospital she was never detected in the act of putting anything into her eyes nor in possession of any agent with which the injuries might have been inflicted. An element of doubt, therefore, remains unresolved. From the literature, however, we see that this impossibility of detection has existed in more than one dermatologic case, even though the best observers were convinced that they could only have been factitious. It is these singular features that constitute my excuse for presenting this case to you and for putting it on record.

DISCUSSION.

DR. F. H. VERHOEFF, Boston: Several years ago I saw a case so similar to Dr. Bruns' that I am wondering whether it was not the same case that finally got into his hands. It was that of a young girl, also scrofulous in appearance.

When I first saw her she had a very slight inflammatory condition of the conjunctiva, of which I made light. Two or three days later she was admitted to the hospital, where she was found to have numerous lesions all over the skin which were suspected to be syphilitic. In addition, she now had a condition of the eye that I had never seen before, namely, a sharply defined gangrenous ulcer of the bulbar conjunctiva extending from the corneal limbus to the equator on the nasal side. Her general appearance and behavior were suggestive to me of hysteria. She said the skin lesions had the habit of bleeding spontaneously in a miraculous manner. I had her put in a room with a nurse to watch her closely, and one day the nurse found her finger-nails stained with fresh blood. It was then easy to understand the eye condition as well as the skin lesions. She had evidently dug her finger-nail into the bulbar conjunctiva and thus laid bare the sclera. In fact, on close examination the flap of conjunctiva could still be made out. Then the dermatologists and neurologists were called in consultation, and they confirmed the diagnosis of hysteria. What the final outcome of the case was I do not know.

DR. H. D. BRUNS, New Orleans: I am glad to hear of another case with features similar to the one I described. It makes my mind easy in thinking that our diagnosis of ophthalmia artefacta was correct. I do not think that the lesions which I saw were made by laceration. They had sharp, clean-cut edges, the lesion itself not dark red, but coal black. Granting that this was a case of ophthalmia artefacta, by what means did the patient make the lesion? I know of nothing applied to the conjunctiva which would make a lesion of that sort. Mackenzie testifies that even sulphuric acid makes a white slough. The lesions had slightly elevated edges, were surrounded by a narrow, reddish line, were clean cut, and the area of the lesion was black. I do not think this girl could have been any relation to Dr. Verhoeff's patient. She never had been out of the State: she did not belong to the class that can travel.

THE PROPHYLAXIS OF OCULAR BIRTH INFECTIONS.*

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Bacteriology upholds a sharp distinction between the virulent and non-virulent organisms concerned with acute inflammation of the eyes of the newly born.

From the viewpoint of prognosis and clinically, this has been long accepted. Formerly, also, a purely arbitrary division assigned a larger share to a supposedly gonorrheal origin and the remainder to other unknown causes. Ophthalmo-gonorrhea is now known to be present in a smaller proportion of the total number of acute lesions. The remaining much larger contingent is caused by mixed infections, some even marked by the apparent absence of organisms.

The modern or more rational care of the eyes of the newly born, at present almost universally taught, enforced, and practised by intelligent lay and professional workers, in direct touch with all except the ignorant pauper classes, has accomplished a vast amount of good, and with more stringent vaginal prophylaxis and added ocular antisepsis for special cases, has greatly reduced both the gravity and the number of ocular birth

* This paper emphasizes the fact that gonococcal conjunctivitis, one of the ocular expressions of venereal disease, is, even at the present, often included and classified under the term ophthalmia neonatorum by many physicians, and some specialists, through wrong diagnosis or intentionally. Also that gonorrhea is not, as formerly and commonly supposed, responsible for a preponderant share of ocular birth infections, even though the gravity and loathsomeness of every real case, now, as formerly, remain unchanged. That it is an unnecessary and preventable ocular lesion of infancy; also that gonococcal conjunctivitis should be declared a contagious disease by our boards of health, and that its only reliable prophylaxis is the suppression of licentiousness among men.

infections of non-specific origin. This will be willingly conceded by all so far as the cases in question are concerned. By many, although with some restriction, this is also claimed for the cases composing the gonorrheal group.

My experience does not support this assumption, and it is questionable whether, for the smaller contingent of true infantile ophthalmo-gonorrhea, the united efforts of humanitarians and social-service workers, obstetricians, practitioners, and oculists have been successful in reducing their number.

Infantile ophthalmo-gonorrhea now, as formerly, reaches and maintains a numerical level which fluctuates but little. The reason for this is evident. The carrier of the gonococcus is, with few exceptions, a human male, who, through gross sensuality or wanton ignorance or other inherent moral turpitude, contaminates or infects the vaginal surfaces of a woman, in most cases, shortly before the birth of her (his) child.

No one will deny that the gonococcus is one of the most vicious of pathogenic organisms. In a specific or gonococcal ocular birth contamination, one or often two innocent victims must bear the brunt of the misdemeanor of a guilty one, who, not always through heedless stupidity, impairs or wrecks the health or usefulness of those who may survive his vicious contamination. Not infrequently one or both seal with their death a crime for which he alone is responsible but from which he escapes, with rare exceptions, without censure.

A smaller number only of infantile ophthalmo-gonorrheal infections can be traced to women as the first and original carriers of this organism.

There are tangible reasons why women are not first or frequent carriers for specific birth infections. Prostitutes who may harbor gonococci in their genitalia and who, through their sexual promiscuity, are exposed to such infections, rarely become mothers. Women legitimately mar-

ried, and those who practise secretly illicit intercourse, and the ignorant or unwary ones who are seduced and become pregnant, are, one and all,—and we can assert this with all fairness and justice,—neither grossly sexual nor sensual during the terminal period of their pregnancy.

No, it is rather their submission to that which may be distasteful, and from disinterested personal motives, that they become willingly the unconscious victims of a danger against which, to say the least, the commonest decency and fair dealing of their male companions should protect them.

Those women contaminated with gonorrhea before or early in a pregnancy, either through present or antecedent misdemeanors of their husbands or male companions, or as a result of their own promiscuity, are dealt with more harshly by this organism. Such unfortunate women rarely have a chance to become mothers or to transmit to living offspring ophthalmo-gonorrhea.

This organism is so viciously destructive to women that sterility, rather than fecundity, and, many times more, hopeless invalidism and even death, effectually prevent more than a very small number from becoming the first or original source of an ocular infection at or during birth.

Clinically, we have two distinct divisions of infantile ocular birth infection. The first comprises the gonococcal ones only. The second, those due to less virulent organisms and the result of ocular contamination or traumatism following protracted or difficult labor, flagrant negligence to mother and child, during and following birth among the ill-housed and indigent poor, who as individuals are uncleanly and frequently harbor microbic organisms in different parts of their mucous and skin surfaces.

For the first (gonococcal) division, my experience can admit a most uncertain prophylaxis only. Gonococcal infections spring up without warning from concealed sources which cannot be discovered in time to prevent or control

ocular infection. Numerically, also, they are subject to rise and fall, and are revealed when least expected among the ignorant lowly and the opulently rich. Their number depends wholly upon the moral iniquity of individuals, and must be charged to the mother herself or to her male companion or companions. That which has been noted by me, and mentioned to interns and those in charge of these cases under my direction in public hospitals, is that infants whose eyes become infected with gonococci presumably at or during birth are, as a rule, strong and well-developed children, born of healthy mothers. In not a few instances have I noticed in private or dispensary practice that a mother's contamination was not suspected until the ocular lesion of her child as certainly pointed out its true nature. Here there is but one inference, and subsequent disclosures will prove its truth, that such women are contaminated late in their pregnancy or shortly before parturition. I have again and again observed the opposite among the progeny of unhealthy mothers with non-gonococcal ocular infections, in which smears and cultures positively excluded a specific or gonococcal origin, that such infants were often premature, undernourished, and poorly developed at birth. These are the cases we meet in the lying-in wards of our public hospitals and also at outdoor clinics, to which charities women flock for whom motherhood is joyless and often repulsive. The point to be emphasized is that therapeutic measures have, in my hands, been more successful with the gonococcal group, if too much time has not been lost before the real character of the ocular infection is recognized, for I have found the larger number of such infants with a healthier physical legacy and, for this reason, with a better resistance on the part of the ocular tissues. Those belonging to the non-gonococcal infections, however, I have more often found marasmic and decrepit from antecedent undiscoverable causes, with little or no tissue resistance and looked

after with indifferent interest by passive and ignorant mothers.

The children of the first or specific group would recover promptly with partial or complete blindness, but with healthy bodies, after an acute and stormy siege, while those of the second or non-specific group would also recover, as often with blind eyes but unhealthy bodies, after a chronic and tedious course, a large number growing into physical and moral degenerates. Later in life such undesirable unfortunates are thrown with more normally developed children, blind also, but from other causes, in public institutions for the education of the blind, schools, etc., where they often prove moral contaminators to their companions through their gross degeneracy. Fortunate, indeed, that we are awakening to the fact that the more normally developed blind children should and must be educated in contact with seeing companions rather than be thrown, in consequence of their blindness, with those among whom must be many psychopathic subjects.

From the fact that gonococcal infection more often occurs in healthy children whose loss in usefulness is unnecessary our attention should be given more vigorously than ever toward thorough preventive treatment for infants of this class who show a better chance of becoming useful members of our city or rural population.

Modern preventive measures systematically and conscientiously carried out have been doomed to sorry failures even in the hands of the most competent oculists and practitioners, when, instead of a non-virulent organism, the gonococcus was found to be the infective agent.

The answer that my experience would suggest is that we have systematically and totally ignored the carrier of the gonococcus. The cases really to be deplored are those in which a specific genital infection is present in one member of a family presumably happily established, and by him

transmitted to an unsuspecting woman (wife) during the time (end of pregnancy) when her attention is engrossed with her own personal discomforts and she is made an unconscious party to his (unintentional ?) perfidy.

We know little or nothing of the time of happening, its first inception, or the mode of an ocular gonococcal infection, but we do know, however, that—

In a gonococcal conjunctivitis, inception and extreme rapidity of progress are coincidental happenings without even a probable inference as to how or when they began. In spite of the most modern and improved prophylaxis, conscientiously and speedily enforced, this vicious pyogenic organism can neither be destroyed, dislodged, nor neutralized. The exact time of its implantation remains a mystery, and an incredibly short interval of time precipitates a vicious acute inflammation, with a rapidity of progress that leaves no doubt or question of its true character.

At this early stage, with the impossibility of determining positively its character even by the most experienced, ignorance or inexperience of those in charge, as well as the difficulty of realizing that they are facing a next to unconquerable disease, permits the short time period when active treatment could alone be successful to pass and the acute progress begins.

Later, and hours only are necessary for this, smears and cultures reveal what may be surmised, for now the organism cannot mask its identity. But it is only in the lying-in wards of public hospitals that an opportunity to do this is offered to those who are on the lookout for this treacherous lesion, and who know its dangers and who can adopt an early prophylaxis which has for its purpose the destruction of the gonococci before parturition. It fails as often here as it more certainly does in private practice. Wherever found, in public hospitals or in private practice, with bacteriologic proof at hand, one or both parents of a legiti-

mate child must be the carrier for an infant's ocular infection. Ten to one, in private practice, its source of origin points to the father. If it is discovered in an illegitimate child or that of an abandoned married woman, in a public hospital or home of the friendless, and sexual promiscuity is admitted or suspected, then it points to the mother. The other alleged causes are so rare and fanciful that they give way to truthful confessions from one or the other of the human agents responsible for the ocular infection. Too much cannot be said in praise of the unremitting vigilance and interest of the medical profession, aided by social-service workers, to control this dangerous disease.

Societies for the prevention of blindness and for the conservation of sight, together with the telling effects of better information in lay and professional circles, have also accomplished much good, but, in my opinion, they all are working along false lines in their efforts to combat this pest of ocular gonorrheal infection. That their combined labors have reduced the number and gravity of the non-specific cases I will support with my experience in all willingness and with additional proof of its efficiency, but that their efforts in reducing the true gonorrheal ones are barren of results, except by the rarest chance, is a depressing conviction of my personal experience.

Infantile ophthalmo-gonorrhea is and remains, as heretofore, the same public menace and a preventable moral outrage upon helpless infancy.

It is not our failure to carry out the best known or generally approved prophylaxis before birth, and an equally rigid one of ocular antisepsis, which consist of the instillation of 1 or 2 per cent. solution of argent. nitr. comp., or any other as powerful antimycotic therapeutic agent, placed by proficient hands in the eyes of an infant, born of a real or suspected gonorrheal mother. Even if this is done before the cord is cut, or immediately afterward, more often than

not it proves ineffectual in stopping what soon develops into a riotous and destructive inflammation. We cannot or dare not assume in all cases, other than the exceptional ones in which we have positive information and the scant proportion in which our suspicions only are aroused and more or less confirmed, that gonorrheal infection is about to happen. In all other cases we can hold only to the conclusion that it is imminent or possible or both. The latter include births amid filth-stricken surroundings, and among indigent paupers, and all legitimate and illegitimate ones, in which the mother must seek the charity of a public hospital. In truth, it applies to any full-time birth of an infant in which sexual promiscuity on the part of one or the other parent can be assumed, even if denied, for gonococcal contamination cannot, in these cases, be excluded, and is more probable than otherwise. For such cases, and for others in which there is given a history of persistent vaginal discharge for a longer or shorter period before the expected birth, every intelligent physician, midwife, trained or monthly nurse would or should adopt and practise at once the most stringent vaginal and other antisepsis as a safeguard against personal dangers to the mother and members of the family. I know positively that those just mentioned, and even oculists, have been wrongly accused in some cases in which one or both eyes of an infant were lost, and the blindness was charged to their negligence or failure to carry out the customary or the best possible prophylaxis. I know of monstrous stupidity and the most wanton carelessness, also, which deserve censure on the part of those in charge of these desperate cases, but I also know of many instances of physicians and midwives who were in charge at the inception of these treacherous cases, upon whom blame was unjustly placed.

Before smears and cultures can be made, even with a minimized delay of hours while the diagnosis is being con-

firmed, even in this short interval, this vicious organism is given a start toward a destructive inflammation, which the most accurately planned and executed vaginal prophylaxis before, as well as the promptest and most rational therapy after, birth fails to stamp out or in any way to influence the unsuspected and hidden implantation of the gonococci.

With these facts clearly before us, we can understand why ophthalmo-gonorrhea will continue its destructive work undisturbed, and defy the best prophylactic measures, claiming its quota of eyes of helpless infants. For, it originates de novo from unsuspected and fresh sources. It is propagated or transported by human (male) carriers. Neither in number nor gravity will the cases decrease so long as adult men and women are kept in ignorance of the hidden and grave consequences of gonorrhea. For this ignorance the age of prudery and false standards in matters sexual, from which we are just emerging, is largely responsible.

This specific organism or gonococcus excites a riotous inflammation in the eyes of infants. It is always acute and, so far as my experience goes, is never chronic. In this it differs wholly from the similar and at times less violent inflammation excited in the genital parts of men and women.

The infantile conjunctiva or mucous lining of the eyelids has, on the part of its fornices, structural peculiarities which must be considered natural safeguards and which offer effectual resistance to pathogenic organisms even as destructive as the gonococci.

Certainly, a similar assertion in regard to specific infection is not histologically true of the conjunctiva of older children or adults. This natural and spontaneous protective measure consists, probably, of the massing of huge numbers of phagocytic leukocytes and antibodies in the larger folds of the reflected regions of the lower and upper fornix, which offer effectual resistance to the ingress of the penetrating gonococci. This is the reason, also, why our

therapy is so much more successful for gonococcal disease in the eyes of infants than in those of adults. Taking advantage of this, and with a knowledge that the inflamed territory is guarded by this increased phagocytic invasion of leukocytes, we can resort to the application of solutions of greater strength for very young infants than would be permissible in the case of older children or adults. This fact the average practitioner does not understand, and his bland solutions are as ineffectual as the water he uses to flush the eyes. He who has watched the excessive pyorrhea this organism produces must be amazed that recovery can take place without visible searing or other changes of the mucous membrane.

Unfortunately, the cornea is not so safeguarded by similarly resistful properties of its leukocytes. The surface of the cornea once abraded, the penetrating power of this organism has free scope. After this it is only a question of hours until destructive ulceration and as frequently complete sphacelation with all its consequences comes about.

The cornea, in the rarest cases only, escapes without injury, while in most or all cases remote consequences for life, such as scars, ectasia, staphyloma, anterior capsular cataract, etc., can be discovered. The largest proportion, however, have sightless, deformed eyes, which should be scathing rebukes to those who are permitted by our present moral standards to inflict this needless deformity and blindness. We all know that partial or complete blindness and ugly deformity, although common, are not the only resultants, for my experience does not differ from that of many others of our number who have had even a larger one in that not only blindness results but not infrequently also an endogenous infection leads to an acute implication of the joints of an otherwise healthy infant, followed by endocarditis and death—a merciful release for the child, although an absolutely unnecessary happening.

I repeat my conviction that the gonococcus is, except in isolated instances, implanted in an infant's eyes from the surfaces of the genitalia of its mother, where it has been deposited by a human male, with few exceptions, the father, at a late period of her pregnancy. This is to be the more deplored as there is no reason why this nasty happening should endanger, through contagion, mother, nurse, and physician—in fact any one who comes in contact with a needlessly infected infant.

If we want to add our share to check the spread of ophthalmo-gonorrhea, we must utilize every channel of information to give men, and in particular intelligent women, a knowledge of the incalculable harm this organism brings about to countless known and a larger number of silent ones of their sex, and which in most instances does not stop short of confirmed invalidism or even death, while to their children it means often the unconscious infliction of unnecessary blindness and in no rare instances even death.

Let us review, with the greatest brevity consistent with the importance of the subject, the pros and cons of the best known means at our command to control ocular birth infections in general or as a whole.

We must admit that they have not reduced the number of the gonococcal ones, while the same or similar prophylaxis has markedly influenced, numerically, those of non-gonococcal origin.

The reason for this is again self-evident, for numerous causes and organisms contribute to the number and gravity of non-specific ocular birth infections, while for the specific a single one only exists.

A non-specific ocular birth infection may happen to any healthy infant, born of an unhealthy, careless, inexperienced mother, when, through defiance of ordinary cleanliness, secretions, dry or moist, containing pathogenic organisms, may find their entrance into its eyes. Such contamina-

tions or secretions are carried, through the hands, fingers, in handkerchiefs or towels, from their original source, the mouth, bronchial tubes, nose, ear, skin, genitalia, etc., of the mother or attendants. A healthy mother may give birth to an unhealthy, undernourished, marasmic infant, whose nasal and other mucous surfaces may, shortly after birth, furnish similar organisms, and these may find their way along various channels into its own eyes. Unhealthy mothers, careworn and overworked and often alcoholic, whose progeny is frequently premature, with unmistakable earmarks of physical degeneracy, will add a large proportion of grave non-specific birth infections, with consequences to sight as destructive as the gonorrheal ones.

These non-specific cases often prove interminably chronic, whereas the specific ones, unless the infant is marasmic besides, run a swift, acute course. Gonococcal cases yield to the right treatment with promptitude, while the others do not respond as quickly to therapeutic measures.

Given a reasonably healthy infant with a specific ocular infection, no matter what its stage or its degree of destruction to vision may be, it is more certainly controlled and cured than the equally grave non-specific one, even if both are exactly treated in hospitals with the best therapy with which our experience has furnished us.

The foregoing statements embody what my experience affirms, that we have a rational and successful prophylaxis and also a more or less reliable therapy for non-specific ocular infections, but I must deny that we have a similarly safe prophylaxis for specific infections, though I do admit and hold that we have a successful therapy after the infection is once declared clinically and too much time has not been sacrificed.

Formerly, as elsewhere stated, all ocular birth infections were indiscriminately regarded as gonorrheal. This imputation was often unfairly attached to the mother or father, or both.

It is impossible, at present, with the aid of bacteriologic interpretation of the pyorrhea and scrapings of the mucous membrane, not to make a correct diagnosis, and, in accordance therewith, to divide ocular birth infections into non-specific or mixed and specific or gonorrheal ones.

In the light of our present knowledge of this subject a term such as ophthalmia neonatorum should become obsolete. He who would call diphtheria of the throat, in which the Klebs-Löffler organism is found, pharyngitis, deserves the same censure as the one who would call an acute lesion of the conjunctiva or eyes in which the gonococcus is present by any other than its true name, ophthalmo-gonorrhea or gonococcal conjunctivitis. It would only be more reprehensible to continue to classify or include indiscriminately the specific with the non-specific, or, as has been done, to call both by one name.

The entire subject of ocular birth infections has for a long time been invested with a silly and false sentimentalism and an evasive handling of the truth or even its complete concealment.

For fear of disturbing that time-(dis)honored professional courtesy, not only to protect and shield the guilty, but even to advance wrong explanations of the nature of the contamination of the infant's eyes, often to trump up fictitious causes and to shift the blame and suspicion to an innocent person, these are only a few of the just accusations which can be made against our profession. More or less, we have all been guilty of such misdemeanors as our experience with these cases has been large or small.

The real point of issue in the question, whether we have a reliable prophylaxis against ocular birth infections, concerns itself exclusively with those caused by a vicious and virulent organism, the gonococcus of Neisser.

Non-specific infections or contaminations may be so mild that they require only the simplest prophylaxis, and, with proper care of the child, cleansing of its eyes, and the use of

mild antiseptic applications, such cases recover promptly without visible trace or complication. If there are no virulent organisms present in an infant with healthy parents, such transitory inflammation of the conjunctiva is due to slight traumatism during prolonged labor or to careless and bunglesome handling of the infant's eyes by an incompetent caretaker or midwife. These are the cases which midwives, monthly nurses, and not a few doctors claim to have cured with remedies of indifferent or absolutely useless therapeutic value. We have had to listen, also, to the similarly fanciful declarations proclaiming the therapeutic acumen of certain physicians and even specialists who have advocated various astringent collyria as almost specifics.

Those best informed will not deny that, if virulent organisms are not present, the cases will make a prompt and complete recovery with medicinal treatment combined with enforced sane hygiene, whether the remedy happens to have been one or the other of the mineral or vegetable astringents, antimycotics or antiseptics. If the gonococcus can be positively excluded, such cases will get well in spite of the remedies resorted to. Fortunate, indeed, are those doctors who attribute to themselves the spurious credit of having treated successfully and cured completely certain mild and non-specific cases, but who, nevertheless, hint at or assume for them a gonococcal origin which they do not and could not prove bacteriologically, and unjustly compare their successes with the disasters of others. These cases belong to the non-specific group, which represents, depending altogether upon the class of patients a physician's clientèle includes, as high as 60 or 75 or even a higher percentage of the total number. An occasional or several successive gonorrheal cases, which drop in like meteorites on earth, are most unwelcome intruders as they blotch the boast of therapeutic success. The ocular birth infections seen by those whose practice puts them in touch with the morally

infirm and the degenerate paupers in hospital or dispensary practice, where the number of specific infections is higher, will require ten times the diagnostic acumen and precision and a therapy which the former, with their more limited experience, cannot, in their highest flights of reasoning, competently grasp.

The really dangerous cases of birth infections, specific or non-specific, can be appreciated only after personal experience of their own horrors and our absolute helplessness to relieve otherwise than to bring the inflammation which has ruined the sight forever to a speedy termination. Every large city and every district of a city, hamlet, or village has and will have its percentage of ocular birth infections. The large number will be of non-specific origin and will spring up anywhere among all classes and in the practice of any physician. These will be augmented from time to time by the dropping in of a single or of a few gonococcal birth infections, and their number will depend on the moral obliquity of an until then unsuspected individual or father of a family.

When this happens, another story is told. Then the blame for the unpleasant occurrence is often speedily shifted to a supposedly ignorant midwife or monthly nurse for failure to carry out a vaunted prophylaxis or to instil an indifferent eye-water. Even though these omissions are possible to those of limited experience, it is, nevertheless, a common shortcoming of physicians and specialists to put the blame somewhere or on somebody, while ever and always they appear to exonerate the gonococcus and his carrier.

The whole subject would lose much of its nastiness if wrong names and explanations were not applied to right and fully known lesions.

We specialists can proclaim, without a dissenting voice from our own number, that:

True gonococcal infections are never mild. All run an incredibly stormy course. Destruction is often imminent or

actually in progress before the danger is realized and the time it might have been averted is long past.

Taking the prophylactic measures against specific ocular infections, my experience has found them inadequate and wanting in reliability; and that the instillation, even of 1 or 2 per cent. solutions of silver nitrate, ever so accurately carried out after Credè's suggestion, does not and cannot abort or stamp out a hidden gonococcal focus in an infant's eyes, *except by the rarest chance.* On the other hand, that a similar or the same prophylaxis for non-specific cases has added its share of good in modifying and reducing both the total number and the gravity of this group is willingly conceded. Successful stamping out of true gonorrheal infections is indeed a rare observation, for we can consider only those cases in which a specific vaginal discharge, with bacteriologic proof, was present some time before parturition. The study of such cases is possible only with the promiscuous material found in the lying-in wards of public hospitals and its uncertain and concealed history on admission.

In private practice, among the legitimately married, for the reason that contamination of a woman late in her pregnancy is a frequent source and, in my experience, about the most frequent, an early and accurate diagnosis cannot be made even with the most expeditiously prepared smears and cultures, and a physician or specialist is thrown on his wits, for such cases will test his experience. It goes without further comment that for these cases, in the light of what antisepsis has taught us, Credè's method, reinforced by any rational means, is the only justifiable course to adopt, and if not immediately enforced must be considered an act of criminal heedlessness. It may be stated and even proved that a parturient woman with gonorrhea does not necessarily infect her infant's eyes. This, of course, advances only another proof of the hidden channel and unknown period along which and within which gonococci may find

ingress to the conjunctival lining of the eyelids. It may also be asserted that, in spite of prophylaxis before parturition and ocular antisepsis at and after birth, gonococcal infection took place. This does not in any way prove the inefficiency of the prophylaxis, but rather points to the fact that gonococci have latent properties of resistance to destruction, or that they have already gained access to the interior of the epithelial cells, and the comparatively mild reaction which the silver salt excites can be easily resisted, rendering it almost as ineffectual as boric acid or other indifferent solution dropped into the eyes.

I do not want to be understood as failing to recognize the great boon of a rational prophylaxis and of ocular antisepsis, or that I do not advocate as well as teach and practice the most rigid antisepsis for both mother and child whenever there is time and opportunity to enforce it. I have found, however, that in lying-in wards of public hospitals, with the aid of trained interns and nurses, and, moreover, with every facility before, during, and after birth to prevent infection by antiseptic instillations of nitrate of silver, such attempts were, to say the least, most uncertain in securing the desired results. No matter how expert an intern, trained nurse, or even a specialist may be, to instil one or two drops in the eye of an infant is a difficult undertaking, as often the silver salt is dropped on the cornea. A more or less violent reaction must and will take place. This, in most cases, is transitory, and though sharp in character is brief in its course and may leave no bad results—perchance, in certain cases, it may accomplish its purpose.

Every woman whom poverty or lack of friends forces to go to a public lying-in hospital rests under the suspicion of a contaminating, promiscuous sexuality, until later bacteriologic disclosures prove positively that she has escaped infection. For this reason we must continue our present next to purposeless prophylactic measures.

Several years ago, mainly through the sentimental agitation of the question of prophylaxis *for all cases of parturition*, a mild phobia spread rapidly and took possession of the minds of many overzealous physicians, and especially of many overconscientious women about to become mothers.

It was another of the many opportunities afforded our profession to take advantage of the credulity of a certain number of our clientèle. In common with others of our number I was appealed to by many women, but especially by those from the more intelligent classes. It did not take a level-headed woman long to decide whether she would permit or sanction a prophylaxis aimed at herself and her child, on an *assumed possibility* of an ocular infection and on the grounds we must mention, if she and her husband understood the full meaning of such purpose, *i. e.*, that it imputed to one or the other, or both, promiscuity in their sexual relations.

I well remember the stormy abuse of an intelligent mother whose overzealous and progressive physician had resorted, without her consent, to the instillation of a 2 per cent. solution of silver nitrate into the eyes of her infant, and a violent silver reaction resulted which lasted several weeks. I know of other cases with disastrous consequences in which, merely on the pretext of being in advance of vaunted advantageous measures, a similar prophylaxis was used without the slightest indication for such a purpose. It is useless again to state that, if we have proof, even on insufficient grounds, it is justifiable to use such a prophylaxis, but without such proof it is not. My public hospital experience has abundantly taught me this, that, unlike that in private practice or even in the case of dispensary patients, among whom specific infection of a mother is more apt to happen during a later period of pregnancy, both mother and child, owing to their more recent contamination, are better examples of health, while the contrary has often been observed;

that listless and indifferent mothers and their infants, in large public institutions, are more often undernourished and unhealthy. The specific acute infection of the former yielded more promptly to treatment than the latter, probably for the reason mentioned of better health and resistance, from the fact that the gonorrheal infection of the former was of more recent date.

Every intelligent physician must acknowledge to himself, his patients, and the public at large that an ocular birth infection is not gonorrheal until it is proved to be so by bacteriologic examination.

Of the total number of cases of both kinds of infection, the non-specific are, with few exceptions, accidents, resulting from bunglesome management, protracted labor, unhealthy, uncleanly mothers, decrepit infants, filthy and unhygienic surroundings, ignorance, poverty, and want. These cases, also, cannot be prevented or stamped out completely. Through the vigilance and the intelligent surveillance of district nurses, boards of health, and social-service workers, the number as well as the danger of these infections has been and will be greatly reduced. There must, necessarily, be many grave cases among the number of accidental or non-specific birth infections, for the reason that both mother and child are often undernourished and marasmic from undetermined causes, and therefore deserve every attention, both prophylactic and therapeutic, just as those in which bacteriologic examination reports more virulent or a specific organism.

Of the total of all cases of ocular birth infections, the specific or gonorrheal are the dangerous ones. These are rarely or never accidents. Their origin can be traced to an existing gonorrheal source elsewhere, and for this reason preventable and unnecessary. Without exception, every case is grave and the prognosis hangs in the balance. Our present prophylactic means are uncertain and unreliable.

There is but one prophylaxis against infantile ocular gonorrheal infections. In every legitimate marriage, as well as illegitimate alliance, in which proof is at hand that promiscuity on the part of a woman (wife), or vice versâ of a man, can be excluded, it must be made a criminal offense, and the guilty one dealt with by our criminal or police courts. Every woman, ignorant or intelligent, should be fully informed as to the nature of her own and her child's condition.

The following statements specify, briefly, the prophylactic measures which have been tested and enforced by me in private dispensary and hospital practice and mentioned and explained in clinical lectures to students and practitioners.

For average births, with a possibility only of a non-specific ocular infection, the best and most reliable prophylaxis consists of the modern method of care taking of infant's eyes, known and practised by every intelligent trained nurse, midwife, or physician. It safeguards the eyes of healthy children born of healthy parentage in a clean sanitary home or hospital. To advise more than this, or even a special prophylaxis for all cases of parturition among the legitimately married with average intelligence and comfortable home surroundings without positive proof or well-founded suspicions, is a meddlesome and tactless suggestion. If a vaginal discharge is admitted and known to be present, prophylaxis before birth, directed to the mother, is imperative, and if this is not specifically explained and enforced, it should be considered a negligent shortcoming on the part of the physician. In such a case the woman should receive full information as to the possibilities, and be instructed to use every means, through cleanliness and antisepsis, to avert an ocular infection during the birth of her child, as this is an imminent although not a necessary consequence.

If bacteriologic examination shows non-specific vaginal organisms, the precautions just mentioned must be reënforced

by greater vigilance and stronger antiseptic means under the direction of a physician and a trained district or private nurse.

If a specific vaginal organism is discovered before birth, energetic treatment, with isolation and surveillance in a hospital or home quarantine, watched over by a trained district nurse, under the supervision, direction, and the personal attention of a trained specialist selected by the local Board of Health.

All cases of women about to be confined in hospitals, or known to physicians as suspects in private practice, should be reported to the local health office, and should remain under its jurisdiction and supervision until parturition is over.

Ocular prophylaxis against possible contamination or infection during birth must be rigidly enforced if suspicion of a vaginal discharge or a known venereal history of the mother supports this. In such cases, on the judgment of the physician, the measures before parturition should be supplemented by careful cleansing of the eyes and the use of a 1 per cent. solution of zinc sulphate, silver nitrate comp., etc., carefully applied as the one in charge may direct.

It is a safe rule to drop these solutions into the eyes of infants with aid of a small skeleton lid-elevator. It is difficult, at best impossible, to open an infant's eyes or to evert the lids, and meddlesome attempts without the aid mentioned land the drops on the cornea, often causing unnecessary injury and needless pain and manipulation.

If suspicions are rife that gonorrhea or other vicious vaginal discharge is present, ocular antisepsis at or during birth is an imperative adjunct to the vaginal treatment before parturition, and if this is not practised, it should be considered an act of criminal and punishable negligence. In such a case the above-mentioned instillation into the fornices of the conjunctiva should be carried out with precision and thoroughness, and by those only who have gained special proficiency in making the application, and again, of remedies of recognized merit, among

which that suggested by Credè ranks first—i. e., *instillations of 1 or 2 per cent. solution of nitrate of silver.*

If a brief passing reference is made to the treatment of a fully declared acute gonococcal ocular lesion, it is mainly to throw the weight of my experience in favor of stronger solutions of silver nitrate comp., of 8 to 20 per cent. solutions. It is the manner of applying the remedy and the selection of the right time or stage which give the therapeutic value to the penetrating application of the silver salt, which must be carefully followed by a weak neutralizing solution.

At the proper time, when the everted mucous membrane is red and succulent and bleeds on gentle or more forceful rubbing with a pledget of cotton, an application of the silver salt can be made with telling results.

This is the time we must take advantage of, the enormous infiltration of phagocytic white cells amassed in the entire conjunctiva and in the region of the upper and lower fornix in particular, which safeguard and effectually oppose the greater transitory reaction which the silver salt excites and which, for the time being, is more violent than that of the pathologic process itself. This superficial and deep penetration causes a greater or lesser destruction of the epithelial layers, and these are cast off in large numbers, choked with gonococci.

Here, also, we may emphasize what should not be done in the case of an infant already under the shock of this infectious lesion. It is better not to resort to clumsy and continuous ice applications, and also to avoid the needless handling of the lids and to abstain from too frequent attempts to cleanse with cotton swabs and flushing, and thereby hope to check the excessive pyorrhea. The keynote of the treatment is the application, once a day, of the stronger silver salt, followed by iced compresses and careful irrigation; while the rest are merely adjuvants to the former, but it must be done by one who has been taught and who has

acquired special proficiency in the making of these applications. Rigid isolation and the services of a trained nurse are, of course, essential requisites for successful treatment of these cases.

Every ocular birth infection should be reported to the local health board or officer, and its specific or non-specific character at once conclusively established by its bacteriologists. Exclusive supervision and treatment of the gonococcal cases must be assumed and directed by the health officer who, in coöperation with a specialist of acknowledged experience, supervises the further progress of all cases reported, and, after impartial examination and investigation, prepare a report to be furnished the presiding judge of the police court for arraignment, censure, or punishment of the one responsible for this misdemeanor, and as a means to furnish the public more convincing proofs of the hidden and unsuspected dangers of gonorrhea, so long and so unjustly considered in the light of benign disease by licentious men.

The cases discovered or brought to the notice of the health officer, if thrown upon public charity, should be placed under the surveillance of the district nurses of the city and be assigned for treatment to men appointed and selected for their proficiency in such cases. The general practitioner has neither fitness, training nor other qualifications necessary to handle these cases successfully, and the same may be affirmed of the average specialist. In the future they will become more than ordinary treatment cases, because the time has arrived when every woman so wronged should have the right to claim redress, even though the punishment of guilty ones may or should be mitigated, until a wider knowledge of the danger of specific birth infections is spread abroad and more convincingly calls attention of the public to the enormity of a misdemeanor which up to the present time has been hushed up without even the censure of those who so justly deserve it. Such arraignments

would at least aid social-service workers to make known the specific danger and to warn pregnant women of the double peril of gonorrhea.

The time is passing when the silly sentimentalism of physicians and the reckless dispensation of the sympathies of social-service workers will be lavished upon licentious men, for we all have known cases where the author of an unnecessary misfortune to an unsuspecting woman and helpless infant was condoled with and fussed over for being the father of a blind child and the husband of a dead, or, let us rather add, worse than dead, invalid wife.

Health boards, for the reason that the dangerous specific cases can so easily be sifted by disinterested and competent bacteriologists, should be counseled to exercise their right of more stringent supervision in co-operation with reputable specialists, who would gladly volunteer their services to aid in the prevention of an absolutely unnecessary destructive inflammation of the eyes of infants.

Bacteriologic registration of every infantile ocular birth infection with a local board of health should be made a compulsory obligation, for this alone can clear up the present uncertainty and confusion concerning the relative and numerical frequency of the various discoverable and not discoverable organisms which are their exciting cause.

As specialists we are called upon to render a diagnosis, prognosis, and to direct the treatment mainly of those cases more certain to be followed by partial or complete blindness, or the grave unmanageable ones, composed of the true gonorrheal and those occurring in the decrepit progeny of physically and morally degenerate parents. Of their separate or combined proportional share to the total number we have at present only a semblance of accuracy, for we rarely see or meet with the larger remaining number which recover or are supposed to do so under the care and treatment which they receive (successfully for all or for most

cases) from general practitioners and obstetricians. For this reason we can neither furnish nor avail ourselves of mutual or reliable statistics concerning the relative frequency of one or the other.

The former—and even at present—widely distributed fear and dread which every case of ocular birth infection excites in the mind of many practitioners and even specialists, who did not or do not resort to confirmatory bacteriologic methods, or who fail to accept the proffered aid which most of our local boards of health extend to us—that every case and the one under treatment in particular may depend upon a gonorrheal or equally dangerous mixed infection, causes them to resort to unnecessarily heroic and drastic measures. Often, to my knowledge, it has happened that on an insecure or an assumed bacteriologic diagnosis, or on the more unfounded assumption that appearances were against mother and child and that the ocular lesion must have a gonorrheal origin, such cases were converted, through the stringent treatment, into unnecessarily prolonged and expensive undertakings for parents, public hospitals, and outdoor dispensaries, or added to the duties of an already overburdened district nurse. At the same time lesions which need not or would not necessarily prove dangerous became so through the invasion of new and more virulent organisms.

For the present and the future our task should be to gather reliable data concerning gonorrheal birth infections for the reason that they are preventable and unnecessary.

Purposely, my estimate from personal experience of fifteen years ago, based upon a larger experience at that time in public hospitals and dispensary practice, was allowed to stand as an introductory statement, or that less than 40 per cent. represented the proportional share of gonorrheal to the total number of ocular birth infections. Since then I

have become convinced that 20 or at most 25 per cent. would comprise numerically the gonorrheal cases.

The conclusions of this paper referring to the bacteriologic diagnosis of gonorrheal and mixed virulent ocular infections were discussed and approved by Professors Wooley and Wherry, of the medical department of the Cincinnati University, and also with Dr. Wm. H. Peters, Chief Medical Inspector of the Board of Health of Cincinnati. Dr. Peters formulated for me the following statements, which I fully indorse as conveying the present-day viewpoint for accurate or scientific bacteriologic diagnosis:

The differential diagnosis of ocular infections in the newly born must necessarily include a consideration of the various exciting causes.

The infection may be due to a single organism or it may be mixed. Simple infections, as a rule, become mixed infections on account of contamination by secondary invaders.

With modern advances in bacteriology that broad classification of specific and non-specific ocular infections in the new-born must fall into disuse.

If the term specific is to be used, it should apply to that acute infectious process of the eyes characterized by a purulent exudate which is caused by the gonococcus of Neisser. A much better term for this infection is ophthalmogonorrhea.

In the past the terms "specific infection" and ophthalmia neonatorum" have applied to those inflammations occurring shortly after delivery, in the eyes of the new-born, the purulent exudate of which revealed, by bacteriologic examination of smear preparations only, the presence of Gram-negative diplococci within the leukocytes.

The gonococcus of Neisser, the meningococcus, and the micrococcus catarrhalis all give up the stain when treated by Gram's method, and there is no difference in the morphology.

It is absolutely impossible to make a positive diagnosis in these infections without studying the cultural characteristics of the organism in question.

The gonococcus will not grow on the ordinary laboratory culture-media, but requires for its growth the presence of blood, and even then it grows sparsely or not at all.

The micrococcus catarrhalis grows luxuriantly upon the ordinary culture-media.

The meningococcus requires a special environment rich in certain carbohydrates for its growth upon artificial media. A history of the case and clinical evidence may rule out the diplococcus meningitidis; not so for the micrococcus catarrhalis, which has a very wide-spread distribution. The micrococcus catarrhalis is frequently found in the vagina. It may also be found on the mucous membrane of the upper respiratory tract. It has been isolated from the pus of appendix abscesses, etc. It is very important, therefore, to rule out the micrococcus catarrhalis.

In some instances a laboratory diagnosis is made without employing the Gram stain, the examiner staining his fixed smear with Loeffler's methylene-blue, and glorifying in a diagnosis which at best can be only presumptive. A peculiar arrangement of staphylococci occurring in pairs and within the leukocytes has been mistaken for gonococci.

An impartial and disinterested judgment, based upon accepted modern scientific investigation, divests this, by many unduly exaggerated and misunderstood subject of ocular birth infections, of much of its unscientific and sentimental coloring.

The following concise summary of the second part of this paper, and intended, mainly, to aid social-service workers to a better understanding of this important subject, explains:

That the largest proportion of infantile ocular birth infections, or 80 per cent., more or less, are largely accidental, and for this reason *cannot be entirely prevented*, even with the greatest foresight and vigilance of physicians and social workers.

That the smaller but infinitely more dangerous proportion of 20 per cent., more or less, is the real point of issue in the question, and that for these we have no reliable prophylaxis. This concerns mainly and applies specifically to the gono-

coccal cases. These are the dangerous and destructive ones. *One and all can or could be prevented.* There is no valid reason why they should happen, for they are invariably caused by venereal disease (gonorrhea) in one or both parents.

There is no reliable prophylaxis other than the suppression and extinction of licentiousness among men and women. As this leads to the needless infliction of an unnecessary and loathsome venereal disease upon an unsuspecting adult and a helpless infant, it should be made a punishable criminal offense, and dealt with as a contagious disease.

It is only through a more widely accessible and more explicit information concerning the hidden dangers of venereal disease that its minor infantile ocular declarations will decline numerically; *its gravity and destructiveness, however, will ever be conserved.*

DISCUSSION.

DR. LUCIEN HOWE, Buffalo: I think we are all under obligation to the writer for bringing up this question, although we have been over it so often. In regard to the invariable use of some prophylactic, we should remember that many cases of gonorrheal conjunctivitis occur in our richest, if not in our so-called best, families. Moreover, there is a way to make the use of some prophylactic universal. That is to obtain a law to the effect that children born in public institutions *shall* have some form of prophylactic treatment used. There is no question as to the justice of that. These children are the wards of the State, and the State has a perfect right to say what shall be done. Then, when the question comes up in private practice, it is easy to say that the State requires this protection for children in public institutions, and should not others born elsewhere have as good a chance?

DR. E. E. HOLT, Portland, Maine: This is a subject in which we must all keep constantly interested because it is ever present in our daily practice. Dr. Sattler has presented

it in an attractive and practical form, and I am sure it will tend to renew and keep up our interest in it. We are indebted to Dr. Howe for the law for the prevention of blindness, first enacted by the legislature of the State of New York, nearly twenty-five years ago, and since then by most of the legislatures of the States throughout the Union. Maine was the first to enact this law after that of New York. It has occurred to me that perhaps along the lines suggested by the writer of the paper it would have been better to have been more explicit in the wording of this law, as its aim is to prevent blindness from infection of the eyes from venereal disease, and have it read: "The Law for the Prevention of Blindness from the Infection of the Eyes from Venereal Diseases."

DR. GEORGE F. FISKE, Chicago: I would say a word in regard to the use of nitrate of silver, which has been advocated for a number of years. I have seen myself four cases where the instillation of 2 per cent. solution of nitrate of silver has caused ulcers on the cornea in twenty-four hours. That is, of course, no decisive argument why we should not use it. It might cause trouble, and it should be watched carefully.

DR. ROBERT SATTLER, Cincinnati: Among the points referred to in the paper, and also again mentioned by Dr. Howe, is the inexpediency of the vaunted suggestion of the use of nitrate of silver solutions in all or most cases of parturition as a prophylaxis against possible or imminent mixed or specific ocular infections. The often harmful result of such practice is explained, and another point also, that the largest number of birth infections are mixed ones, and not necessarily due to virulent organisms, and that a smaller number only, or 20 per cent., more or less, represent the really gonococcal or dangerous and preventable ones. Another purpose of the paper is to furnish social-service workers more reliable data for the discovery of these really dangerous or gonococcal cases, and to point out another erroneous conclusion that an ocular birth infection is not infantile ophthalmo-gonorrhea until smears and cultures made by a disinterested bacteriologist prove it to be so.

AN UNUSUAL CASE OF STAPHYLOCOCCUS CONJUNCTIVITIS.

WILLIAM H. WILDER, M.D.,
Chicago.

AND DAVID J. DAVIS, M.D.,
(By Invitation).
Chicago.

The following case presents such unusual features that I desire to present the report of it to this Society.

A frail-looking, poorly nourished colored woman, aged thirty years, consulted me at the Illinois Eye and Ear Infirmary May 12, 1908, for a peculiar conjunctivitis of the left eye, which, she said, had continued for two years. It began with swelling of the lids, considerable pain and redness of the conjunctiva, and a moderate amount of mucopurulent discharge. A few weeks after the trouble began she noticed that a layer of greenish material developed on the conjunctiva of the lower lid, and occasionally spots of the same material could be seen adhering to the cornea and to the upper lid. Six months later the right eye became affected in the same way but in a less degree. She was under treatment for the trouble in a general hospital and the greenish material almost disappeared. At the time I first saw her, the following was noted:

Right Eye: There were several areas in the inferior fornix that showed a greenish discoloration that, she said, were left after the subsidence of the trouble in the eye one year before. Cornea clear. V. sph. $+4.25\frown$cyl. $+2$, axis $75° = \frac{20}{30}$.

Left Eye: Conjunctiva swollen and reddened and in the lower fornix were large patches of a greenish crust firmly adherent to the membrane, and when these were removed,

requiring some force, there was left a bleeding, ulcerated area, with slightly thickened border.

The patient stated that for several years she had worked in a photographic laboratory, mixing and handling the chemical solutions used in the place.

Examinations of the crusts failed to reveal any metallic substances to account for the greenish color.

Although the left cornea was clear, and the media and fundus of that eye apparently normal, the vision was only $\frac{4}{200}$, not improved with sph. +2.50, the proper correcting lens. She stated that the vision of that eye had always been poor, so I assumed the amblyopia was congenital. She suffered a great deal from bladder trouble, and before the study of the case could be completed she was sent to a general hospital for treatment, and for a time passed from my observation. She was again seen December 22, 1910, two and a half years after her first visit, and stated that in June, 1910, the left kidney had been removed at the Cook County Hospital, which, on examination, proved to be tubercular. She stated also that the condition of the lid had improved considerably in the last two years, and there were times when it seemed almost well, but in the last two months the same trouble had recurred in the left lower fornix. There was considerable discharge of pus from the conjunctiva, and examination showed thickening of the tissue of the fornix, a kind of a flat, granulomatous mass, springing from a superficial ulcerated area, and covered with a tough, greenish, firmly adherent crust. Attempts to remove this caused bleeding. Some spots of greenish material were seen on the conjunctiva of the upper lid near the margin. When the lower lid was everted the whole mass rolled out like a tumor.

The conjunctiva of the right inferior fornix showed the same streaks of greenish discoloration that had been noted two years before, but there had been no ulceration nor recurrence of the trouble in that lid since the first attack. Cultures and smears from the discharge and from the crust showed staphylococcus aureus; no tubercle bacilli were found, nor did a small section of tissue removed from the edge of the ulcerated area show any evidence of tuberculosis. She denied any venereal infection, and a Wassermann test proved negative.

M. L. Appearance of the inferior fornix, which was thickened, ulcerated, and surmounted by a greenish crust (March, 1911).

M. L. Appearance a few weeks later, after the crusts had been removed and the ulcer scraped, showing the rapid development of the pigmented exudate in and upon the conjunctiva (April 10, 1911).

The patient was anemic, weighed only about ninety pounds, and had a slight cough. Fine moist râles were heard over the apex of the left lung. Heart was normal. A tuberculin test was positive so far as general reaction was concerned, and the temperature rose to 100° F. Two doses of $\frac{1}{500}$ mg. of tuberculin were given with an interval of one week. The eye was treated with boric-acid irrigation several times daily and argyrol applied to the ulcerated area after removing the crust. It was astonishing how rapidly the greenish crust would return after its removal, and it was suspected that she might be inflicting injury on herself by putting some foreign substance in her eye, but careful watch failed to detect any such offense.

January 7, 1911, she had headache, dizziness, diarrhea, and vomiting following the administration of $\frac{1}{500}$ mg. of new tuberculin. She also had chills and a temperature of 99½° F. Urinalysis showed albumen but no casts. Pus-cells and numerous cocci and bacilli were present. For several days the diarrhea and gastric disturbance continued with temperature that seemed to be septic in character, at times nearly normal, and once, on January 11, as high as 102½° F. She was then removed to a general hospital, where, after a short time, she improved and went home.

The condition of the conjunctiva was much better, but there was still a tendency to the formation of the greenish exudate.

She passed from my observation for more than a year, and then appeared in the clinic again February 27, 1911, with the same condition of the conjunctiva of the left lower lid. The tissue of the fornix was thickened and bulging, and an ulcer of 10 or 12 mm. diameter was present, covered by the peculiar greenish crust, resembling in color some copper salt, and firmly adherent to the underlying tissue. When the lid was everted, the thickened ulcerated fornix, surmounted by the green crust, would roll out like a tumor, and from the edges of the ulcer purulent secretion escaped. The appearance is well represented in the colored drawings.

From the greenish, crust-like exudate covering the con-

junctiva, smear preparations were made and stained with various dyes. Pus-cells were always abundant. In some smears no bacteria of any kind were found; in others large numbers of Gram-positive cocci appeared, suggesting that they occurred here and there in clumps, as was afterward shown to be the case by examination of sections of the tissue. These organisms as seen in the smears had the morphology and arrangement of staphylococci (Fig. 1). Careful search was made for parasites, especially fungi, such as actinomyces, sporothrix, blastomyces, etc., without result.

A small piece of the conjunctiva together with the exudate was excised, sections of which were made and stained by various methods, including hematoxylin and eosin, Giemsa, methyl-green-pyronin, and Gram. The sections reveal definite small ulcers of the conjunctiva. Fig. 2 is a photograph through the margin of such a lesion showing the discontinuity of the epithelium and below a distinct mass of cocci; Fig. 3, higher magnification. Immediately about the cocci the tissue is necrotic, but farther away is a well-defined zone containing enormous numbers of polynuclear leukocytes, which form a definite pyogenic membrane. Careful search in all the preparations failed to reveal a structure about the bacterial mass suggesting the capsular substance described in cases of botryomycosis. Fig. 2 also shows an exudate which covers the ulcer and the epithelium and which is composed of pus-cells and a hyaline-like substance in places distinctly greenish in color. This exudate is not limited to the ulcerated regions but covers extensive areas of epithelium.

Fig. 4 shows a section at some distance from the ulcer. Here the exudate is thick and dense, but of the same general character. It may be in close opposition with the underlying epithelium, but a line of separation easily forms, as can readily be seen at the left of the section. The epithelium has been everywhere invaded by leukocytes, and they

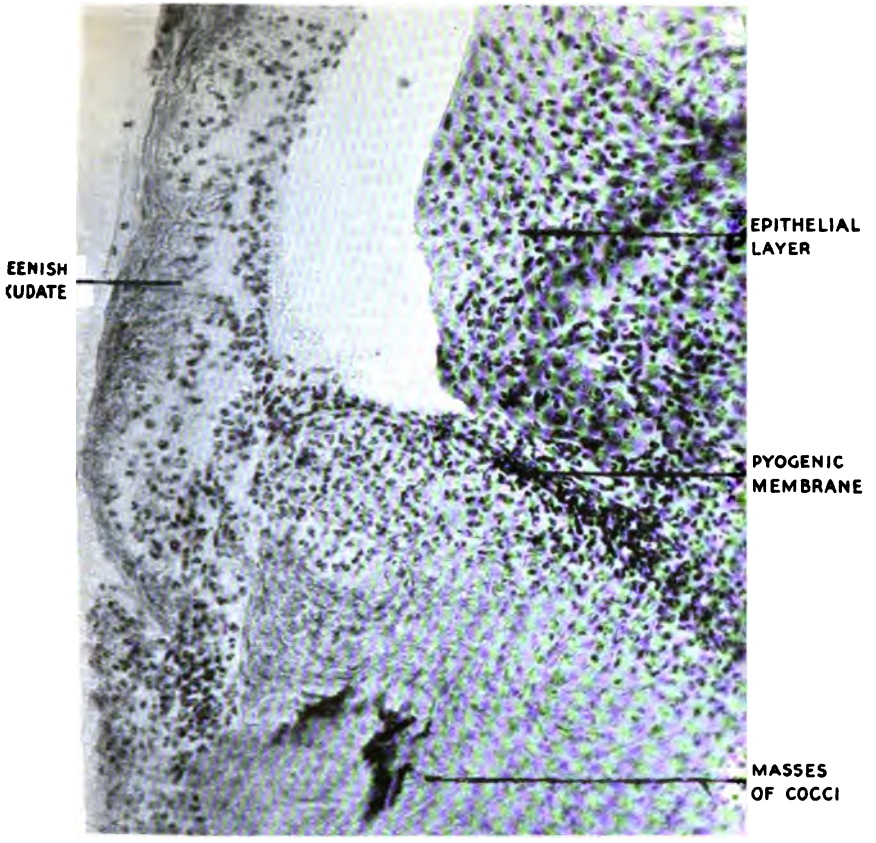


Fig. 2.—Section through margin of ulcer. At the bottom are seen masses of cocci surrounded by necrotic tissue. Above is the exudate composed of pus-cells and a hyalin-like substance which in the sections often shows a greenish tint. Hematoxylin and eosin. × 235.

Fig. 1.—Direct smear of conjunctival exudate, showing the staphylococci singly and in clusters. Gram stain. × 1200.

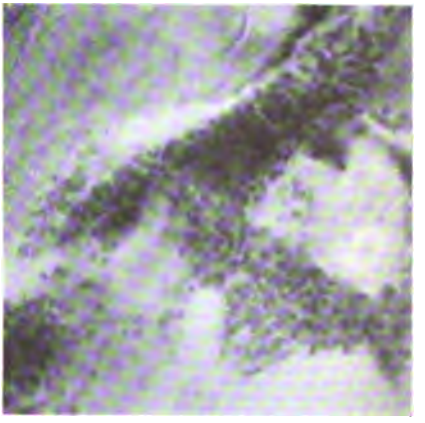


Fig. 3.—Masses of cocci in stained sections. × 1200.

have also penetrated the exudate, especially its lower layers. Above these cells one sees the desquamated and hyalinized forms of epithelial cells, and it is here that one finds regions which appear like hyaline substance and which have in the sections a distinct greenish color. In this particular section the greenish tint was especially conspicuous at a point near the center and just above the epithelium. Generally the greenish color is largely but not entirely limited to the exudate above the epithelium. Here and there one sees small masses of greenish, homogeneous, hyaline substance in the subepithelial tissue always just beneath the lowest layers of the epithelium and never deeper. About such masses are seen occasionally large multinucleated cells, evidently foreign-body giant-cells which lie close to the margin of such masses. Fig. 5 shows such a mass of homogeneous green tissue just beneath the epithelium and at one side is a giant-cell encroaching upon it. The greenish substance is never seen in the epithelium itself.

In the subepithelial tissues are enormous numbers of plasma cells occurring especially about the smaller blood-vessels, and here and there in rather diffuse masses. There is nothing seen in any of the sections that suggests a tuberculous or syphilitic process.

Cultures made from the exudate yielded on several occasions pure growths of a staphylococcus. This organism grew readily on various media, liquefied gelatin in a manner characteristic of ordinary staphylococci, and produced a distinct golden pigment on media, especially on potato. Milk was acidified and coagulated, and on blood-agar plates a moderately wide zone of hemolysis appeared about the colonies. No indol production. The use of sugar culture-media especially designed to grow fungi yielded no growth of such organisms.

Two or three drops of a suspension of this staphylococcus were injected by means of a fine needle beneath the con-

junctiva of a rabbit. Three days later a minute white abscess appeared at the point of inoculation. This slowly enlarged, and on the sixth day after injection a small but distinct ulcer 1 or 2 mm. in diameter formed in the conjunctiva. The center was slightly depressed and the margins were somewhat raised. Cultures carefully made from the base gave pure growth of staphylococcus aureus. A second similar injection was made into the conjunctiva of the animal with identical results and recovery of the inoculated coccus. The ulcers were practically healed at the end of about ten days, and only a slight scar remained. At no time was there a trace of any greenish exudate similar to that appearing in the patient.

A guinea-pig was inoculated subcutaneously with ¼ culture of the staphylococcus. A localized abscess formed at the site of injection, which increased in size for a few days and then slowly disappeared without killing the animal.

This staphylococcus, therefore, appears to be an organism of rather low virulence. It may be stated, furthermore, that there is no reason, either from the cultural or pathogenic properties of the organism, to associate the greenish color of the exudate in the patient with the growth of the organism. If there is any relation, it is probably due to some peculiarity of the patient rather than to any peculiar property of the staphylococcus.

The greenish-blue exudate obtained from the conjunctival surface of the lower lid has the following properties: It is insoluble in water, alcohol, and chloroform. Nitric acid (15 per cent. in 95 per cent. alcohol) does not dissolve it. Weak alkalies do not appear to alter it, but 20 per cent. KOH destroys it gradually, so that at the end of about two hours every trace of color has disappeared. Ammonia does not cause the color to reappear. Special stains for the presence of iron in the pigment gave negative results, and tests for copper were negative.

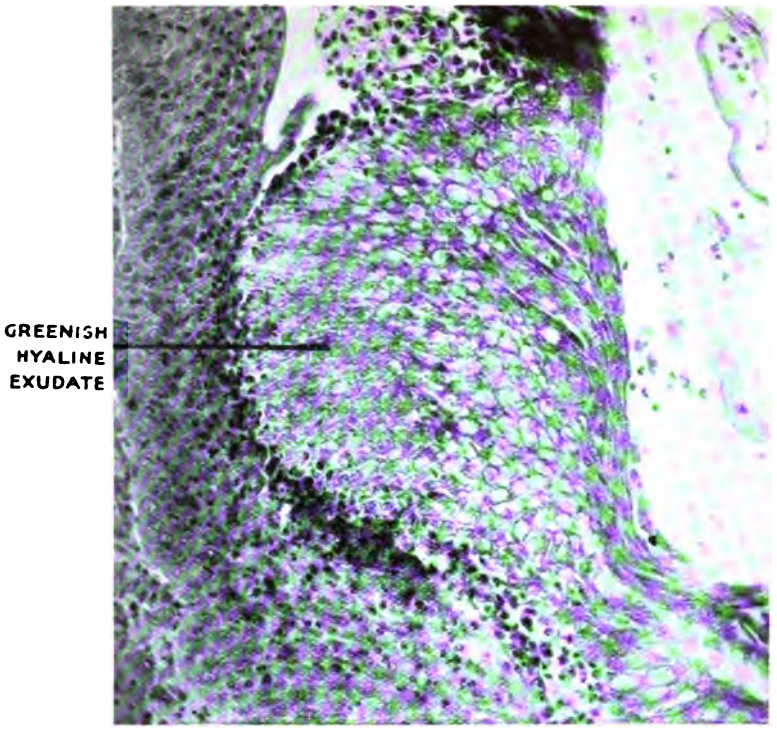


Fig. 4.—Section of conjunctival epithelium and exudate. This exudate in places possesses a greenish color. × 235.

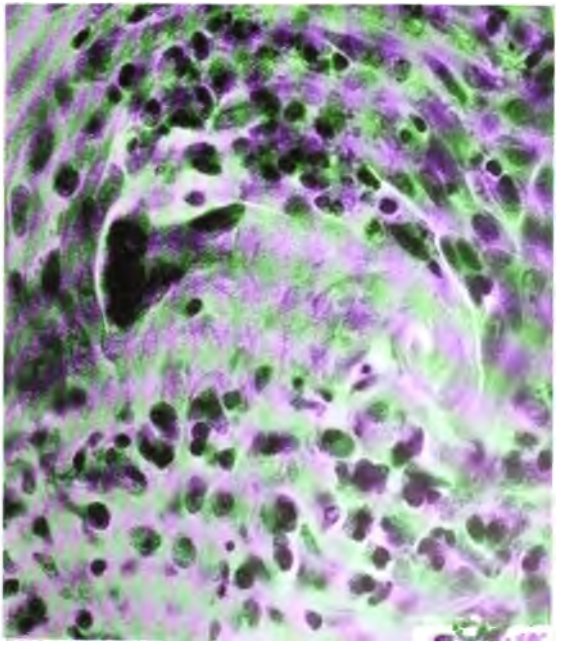


Fig. 5.—Section through a greenish, hyaline mass which appears just beneath the epithelium. At one side is seen a multinucleated giant-cell encroaching on this material.

Treatment.—An autogenous vaccine was prepared, and on September 11, 1911, 250,000,000 staphylococci were injected subcutaneously into the arm. Next day there was some soreness at the site of injection and the patient complained of feeling badly.

September 18, 1911, injection of 250,000,000; reaction about the same as after previous injection.

September 26, 1911, injection of 250,000,000; complained of little reaction after this inoculation. Condition of the eye is improved, but there is still considerable greenish crust.

October 3, 1911, injection of 250,000,000. Eye appeared about the same as on September 26.

October 15, 1911, injection of 250,000,000. The eye is about the same—possibly slightly improved.

The local treatment consisted of irrigation with boric acid solution, which the patient did herself. Some time after the last inoculation she passed from observation and was not seen for more than a year, when it was observed that the lesion of the conjunctiva had completely healed. She had secured work that kept her out-of-doors the greater part of the day, and her health was much improved. She stated that the greenish crusts disappeared gradually and the conjunctiva had healed completely two months after the treatments by inoculation. One of the photographs shows the appearance of the eye April 1, 1913. The conjunctival surface is smooth, but there is considerable scar-tissue beneath the surface. The upper lid is of normal appearance.

The classification of this case is difficult. It presents some points of similarity to "granuloma pyogenicum" or botryomycosis, first described by Poncet and Dor and later by Chambon, Brault, Bodin, Hartzell, and others, but the lesions they described occurred on the skin and not on the mucous membrane. Although in the present case numerous colonies or masses of staphylococci were found in the submucosa,

these were not surrounded by a capsular substance as has been described in some cases of so-called botryomycosis. Poncet himself, in later communications, admitted the non-specific character of the yellow masses he had found in botryomycosis, and thought they might be masses of cells that had undergone some peculiar degeneration.

Hartzell concludes that cases of botryomycosis have no specific character, but are nothing more than granulation-tissue tumors, and the micro-organisms found in them are nothing more than the yellow staphylococci of suppuration. It is not unlikely that such granulomas could or do form in the conjunctiva.

The strikingly peculiar feature of this case, however, was the greenish exudate that formed so rapidly on the surface of the granulomatous mass, even after it had been removed, and the hyalin-like masses of greenish tint in the subepithelial tissue, as shown in the sections.

These would seem to indicate either some peculiar chromogenic character of the tissues or of the organisms found in them. Such a property, however, was not found in the staphylococci when cultivated or when inoculated into animals, and hence one resists the temptation to assign a specific character to such a condition by designating it granuloma viridis. Similar cases may appear at some future time, the study of which may throw some light on this peculiar condition.

DISCUSSION.

DR. F. H. VERHOEFF, Boston: I have just had an opportunity to glance at the sections of this case, and I believe the staphylococcus had very little to do with the condition, and was simply a secondary invader. I think the greenish bodies which occur beneath the epithelium and deep in the tissue are undoubtedly the cause of the lesion. They are very numerous, and many of them are strand-like in appearance. They have attracted endothelial phagocytes,

Staphylococcus Conjunctivitis.

Large shallow ulcer on swollen, thickened tissue of left fornix, covered with granulomatous mass of greenish exudate. April 1, 1911.

Staphylococcus Conjunctivitis.

Ulcer healed, conjunctiva smooth, but containing considerable scar tissue No greenish deposit. April 1, 1913.

and some of them are surrounded by giant-cells. Possibly they are vegetable parasites of an unusual kind. The possibility also must be considered, however, that foreign substances may have been put into the eye by the patient.

DR. LUCIEN HOWE, Buffalo: In the Transactions of the Society about ten years ago there appears a description of two cases very similar to this. The first child, a girl, came to the infirmary with an exudate on the conjunctiva which was so thick that it was possible to remove it one day, and the next day it reappeared. That child ultimately went to the blind asylum. A brother later developed the same condition. I showed that boy at the meeting of this Society in Washington. With the exception of the bright green color of the deposit, the clinical features were similar to those of Dr. Wilder's case. The bacteriologists then were apparently just as much in the dark as the bacteriologists of today, but ultimately improvement began, and one eye became normal. The other had a considerable corneal cicatrix.

DR. D. J. DAVIS (by invitation): The chief point of interest, of course, in this unusual case is the presence of the peculiar green or greenish-blue color of the exudate. This color apparently has no connection with the presence of the staphylococci, first, for the reason that it is not especially abundant near or about the clusters of cocci in the lesions; and, second, because the pigments which staphylococci produce are fatty in character and hence are soluble in fat-solvents. This greenish substance, as stated in the paper, is quite insoluble in alcohol, ether, and chloroform. Moreover, in the animal and on culture-media there was nothing peculiar in the way of pigment production.

The possibility that the color might in some way be related to the color production that appears in certain rare conditions known as ochronosis was thought of. These patients usually have alkapton in the urine. A careful search for this substance in this patient failed to reveal it. The color does not suggest a melanin-like pigment, for pigments of this group are always dark brown or black. Again, a greenish color appears in the group of tumors known as chloromas. The exact cause of the color in these tumors is not known, but it fades on exposure to the air and reappears on treating

with ammonia—properties which the conjunctival exudate does not possess.

The above facts, together with the proof that it is not an iron-containing pigment, would seem to exclude it from the various classes of those biologic pigments about which we at present know anything. This, of course, makes one think all the more strongly of a pigment originating from some extraneous source.

DR. WILDER: As we stated, a careful search for fungi, such as aspergillus, actinomyces, sporothrix, blastomyces, etc., gave negative results. Possibly the tissues in this individual have some peculiar chromogenic properties, analogous to those rare cases of chromidrosis in which there occurs a secretion of colored matter by the skin.

A CASE OF CONGENITAL APRON OF THE PALPEBRAL CONJUNCTIVA.

HENRY H. TYSON, M.D.,
New York.

In 1899 A. Schapringer reported* eight cases of congenital apron of the palpebral conjunctiva observed by him, and referred to two other cases described by Harlan† and de Schweinitz,‡ which he considered were similar cases, although they were not reported as such by the authors. These cases being all that were found by me in the literature on the subject, the report of an additional case may prove of interest.

Mrs. R. G., aged forty years, a native of Unguar, Hungary, applied for treatment at the New York Ophthalmic and

**Zeitsch. f. Augenheilk.*, 1899, Bd. ii, p. 41.
† *Trans. Amer. Ophth. Soc.*, 1895, p. 418. ‡ *Ibid.*, 1895, p. 422.

Aural Institute on account of poor vision in her left eye. V. O. D. = $\frac{20}{30}$, with +0.75 D. = $\frac{20}{20}$; O. S. = $\frac{3}{200}$, with —10.00 D. = $\frac{20}{100}$. The fundus of the right eye was normal, while in the left eye there was sclerochoroiditis posterior.

Upon eversion of the upper lid of her left eye the tarsal portion of the conjunctiva presented an appearance as if a fold of conjunctiva, extending nearly the entire length of the lid, 28 mm. long and 5 mm. wide, near the fornix, had been pinched with a pair of forceps, had been lifted up and then pressed back against the center of the tarsus, and had adhered to it along the upper edge of the fold, which was slightly irregular in contour. Near the temporal margin of

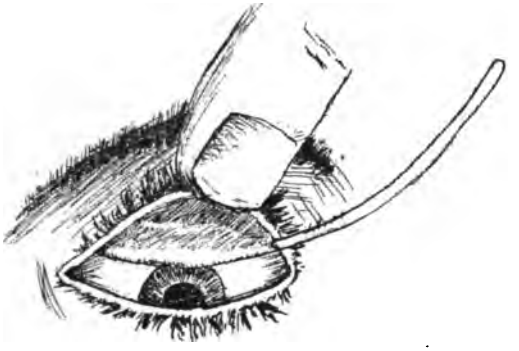


Fig. 1.—Congenital apron of the palpebral conjunctiva.

the palpebral conjunctiva, 3 mm. from the external canthus, was a horizontal slit-like opening, 4 mm. long, that admitted the largest Bowman probe, which could be passed freely between the layers of the conjunctival fold and the tarsus for a distance of 25 mm., almost to the inner angle of the eye. About midway, a fibrous thread or band could be detected which caused a slight narrowing at that point. The color of the fold or apron appeared a trifle gray compared with the normal conjunctiva, but was transparent enough for the probe to be seen through it and observed the entire length. No other malformation of the lid was present, nor was there any evidence or history of trauma, trachoma, or conjunctival disease. The lids of the right eye were normal, excepting a

slight vertical groove in the upper tarsus near the inner angle.

In addition to the cases reported, and the one here presented, Dr. Schirmer, in a personal communication, stated that he had seen two cases in Europe of partial conjunctival apron, but that neither one was as complete as this case.

As to the explanation for the occurrence of the congenital apron of the palpebral conjunctiva, the one given by Schapringer is as satisfactory as any. He stated that, admitting that during the embryonal life the amnion adhered to the layers from which the lids would be formed, and that, by pulling, a fold in the future conjunctiva originated, later the amnion separated from these tissues and the fold remained permanently.

In all the cases except two the apron was partial. It occurred on both the upper lids in three cases, on the right upper lid alone in two cases, on the right lower lid (in conjunction with left upper) in one case, and on the left upper lid alone in five cases. Frequency of occurrence was about equal in both sexes. None of the cases complained of anything in connection with the malformation of the conjunctiva, the condition being observed during the regular course of examination of the eyelids. A striking coincidence is the fact that, with the exception of the cases mentioned by Harlan and de Schweinitz, they all came from Russia, Galicia, Austria, and eastern Europe.

REPORT OF A CASE OF BILATERAL CONGENITAL PTOSIS RELIEVED BY THE MOTAIS OPERATION.

B. R. KENNON, M.D.,
Norfolk, Va.

The comparative rarity of ptosis of sufficient degree to warrant operative interference makes the number of cases that fall to any one of us few. This, and the excellent result obtained in this case, is my apology for reporting it.

Having met with failure to correct the deformity by means of the de Grandmont operation in one case and the results being far from satisfactory, although the ptosis was corrected, in two cases in which the Panas operation was employed, I sought for some method to overcome these difficulties, so when I read the account of the Motais operation by Dr. H. D. Bruns, of New Orleans, I was struck with the fact that it apparently met the necessary requirements in that it corrected the deformity and made no scar; therefore I employed it in the case which I am reporting. The objection to the Panas operation is that it causes more or less disfigurement in all cases and may leave a permanent annoying fistula.

Briefly, the technic is as follows: After the usual aseptic precautions the tendon of the superior rectus is exposed and the incision in conjunctiva carried upward, an assistant pulling the lid upward as far as possible with the finger. The lid is then everted and the incision carried on through the cul-de-sac and on to the conjunctiva of the lid to the upper border of the tarsal cartilage. A strong silk suture threaded on two short curved needles having been prepared,

a tendon hook is passed under the tendon of the muscle, and one of the needles is passed through the tendon and out again so as to include its middle $\frac{2}{4}$. The suture is now firmly tied around this middle $\frac{2}{4}$, and that part of the tendon cut from its attachments to the globe and the incision extended upward until a narrow ribbon of muscle about 12 mm. long is isolated.

With a dull pointed scissors a channel is now dissected from the margin of the tarsus where the conjunctival incision ended and between the tarsus and the skin to the ciliary margin. One of the needles is now passed through the channel and made to emerge through the skin just above the cilia near the center of the lid, and the second needle is passed likewise, piercing the skin 3 mm. from the first. Gentle traction is now made on the sutures, and the muscle slip is pulled into the channel in the lid until finally its end is drawn quite down to the ciliary margin, when the sutures are tied over a small piece of folded gauze. The incision in the conjunctiva is now sutured with great care with fine silk, that of the globe over the remaining superior rectus muscle and that of the lid over the muscle slip now attached in the lid. Especial care should be taken to carefully coapt the conjunctiva at the fornix, as a disregard of this precaution has led to prolapse of the fornix conjunctiva.

The immediate effect should be a considerable overcorrection. After both operations, the eyes could not be completely closed for several days and precautions should be taken to avoid an exposure ulcer. In neither of these eyes was there any injury to the corneal epithelium, and the final result, as can be seen from the photographs, is quite satisfactory.

The patient, J. H. H., aged six, had a congenital ptosis of both eyes of such a marked degree that the lids were separated only 3 mm. at their centers, and only the lower border of the pupils showed in the palpebral fissures unless the head

Bilateral congenital ptosis—before operation.

Bilateral congenital ptosis—three years after Motais operation.

was thrown back about 20 degrees. The operation on the left eye was done July 23, 1907, and that on the right eye, September 9th of the same year, under ether anesthesia.

I followed strictly the technic in Dr. Bruns' article above referred to, except that I transplanted the middle $\frac{2}{4}$ instead of $\frac{1}{3}$, as the superior recti seemed quite small, and instead of cutting the stitch, I twisted it each day until it came away.

The photographs shown were taken three years apart, the first just previous to the operation and the other about a year ago, which shows that the result is a permanent one. It has not changed in the least since the reaction following the operation subsided. The movements of the eyes upward are somewhat but very slightly impaired.

I am aware of the fact that this operation has been condemned for cases of monocular ptosis on account of disturbances to the vertical balance. Of this, I cannot speak, as I have had no opportunity to use it in such a case, but the excellent result in this patient makes it, to my mind, an ideal procedure.

DISCUSSION.

DR. E. E. HOLT, Portland, Maine: I had a case of ptosis of the left eye in a maiden lady, aged thirty years, who consulted me in December, 1910. Three operations had been performed for the correction of the ptosis—two of them by a Boston oculist and the other by myself, without success. With the assistance of my son I performed the Motais operation, very much as described by Dr. Kennon. At first there was diplopia, but that has passed away except when she looks in the extreme upper part of the field. She is able to use the eyes in binocular fixation, and is very well satisfied with the result of the operation. As the central third or half of the superior rectus muscle is a pretty delicate bundle of muscular fibers to handle, it seemed to me that in connecting them to the tarsus and the levator of the upper lid they served as a medium to be reinforced by exudates, and thereby make a firmer connection between the tarsus

of the lid and the superior rectus muscle. The result obtained in an operation which has for its object the utilization of the action of the superior rectus muscle to raise the upper lid is far superior to any other with which I am acquainted, in that the lid moves upward naturally with the eyeball.

DR. EDWARD JACKSON, Denver: I have done Motais' operation in three cases, and I think that, on the whole, it is the most satisfactory operation for cases to which it is suited, cases of complete paralysis of the elevator of the upper lid and the eye otherwise in good condition. Like Dr. Kennon, I have used about the middle half of the width of the tendon to attach to the upper lid. The last operation that I did was on a monocular case, and the result was thoroughly satisfactory. There was a little diplopia the first few days after the operation, which quickly passed away, and there has been no complaint since, now about two and one-half years. For a time after the operation the effort to close the eye tightly, attended with a rolling-up of the eyeball, causes a peculiar pulling-up of the upper lid. In a case I operated on almost ten years ago, after a few months this trouble had passed away entirely, and his control of the lids became perfect. He closes his eyes without any tendency to retraction.

DR. CHARLES W. KOLLOCK, Charleston, S. C.: I wish to report briefly two cases upon which this operation should be performed. About fifteen years ago two Jewish boys, brothers, were brought to me. They were members of a large family, and were the only ones affected. They were born in sequence, and were affected exactly in the same way by a congenital absence or paralysis not only of the elevators of the lids, but of the superior recti muscles, so that when they looked they held their heads thrown far back. I operated upon both without appreciable benefit, and they passed from view until a few days ago when I met them again, now grown men, but not improved. The eyes of both were also highly hyperopic and amblyopic. That two such cases should occur in the same family where no others were affected is interesting.

DR. H. D. BRUNS, New Orleans: It is a great pleasure to

me to find that somebody is beginning to do the Motais operation. There was a time when I could see in the eyes of my audience that they took what I said of its advantages with a considerable grain of salt. I have done the operation 12 or 13 times. Of course, I failed in my first. After slight experience one obtains a success unequaled by any other method of managing this unfortunate condition. However, if one be prejudiced against it, let him remember that if he makes a Motais operation and is dissatisfied, that does not prevent his making later any one of the classic operations in which the lid is attached to the levator of the brow. As to the question of doing the operation in monocular cases, I have done a good many in monocular ptosis. There is usually some little diplopia at first, but it is always overcome. I do not agree with Dr. Holt in regard to the exudate. If a Motais operation is properly done, you can evert the lid just as completely as you can any other lid, and you do not see any trace of dragging at the cul-de-sac. The cul-de-sac ought to be as free as in the normal eye. Motais pointed out when he first wrote of the operation the necessity of being careful in closing the incision in the fornix to have it entirely free, and the stitches put in superficially. The fault of all other operations for ptosis is that they fail when the patient looks up. When he wants to turn his eye upward, the lid does not follow the eye, but he has again to throw his head backward and superelevate the brow. In the Motais operation the more the patient rolls his eye up, the more the lid is lifted by the superior rectus. I think it a great pity that so many extremely artful, successful operators should go on wasting time with the old ptosis operations, with their incomplete non-physiologic results, when they have at hand an operation like Motais', which should be tried first as the operation of election, and then, if it fails, you are perfectly at liberty to connect the eyelid with the elevator of the brow.

DR. B. R. KENNON, Norfolk, Va.: I believe that the muscle attaches itself and remains muscle tissue in the lid. I can evert this boy's lids, both of them, and there is no evidence of a cicatricial band running down the lid. The refraction in this case was practically normal. His vision was $\frac{20}{15}$.

DISCISSION OF THE CRYSTALLINE LENS.

EDWARD JACKSON, M.D.,
Denver, Col.

Improvement in the more common and important operations to be done on the eyeball will come through greater exactness in planning and executing each particular step of operative procedure; and with such improvement a wider field for its application. The procedures for cutting or breaking up the crystalline lens are rather loosely described in our standard works on ophthalmology, and they are often executed without attention to details which will determine their safety and the success that will be attained. Discission of the lens aims to cause disintegration of the lens substance, so that it may ultimately be removed by absorption. The change in the lens substance begins with clouding and swelling. It gradually becomes more opaque, friable and liquid, and this is followed by absorption.

The case being a proper one for discission, the eye is prepared by full dilatation of the pupil with atropin, and local anesthesia secured by two instillations of a 4 per cent. solution of cocain, which will help to dilate the pupil. Kuhnt (*Zeitschrift für Augenheilkunde*, xxvi, p. 430) states, with emphasis, that complete general anesthesia is essential, and others take this ground. Perfect steadiness on the part of the patient is very desirable, and if complete general narcosis were only a matter of trifling inconvenience, it would be desirable. Unfortunately, general anesthesia may be an extremely serious matter; and in adults and in older children it is unnecessary. If the lids be separated and the eyeball steadied by the fingers of the operator, very fair

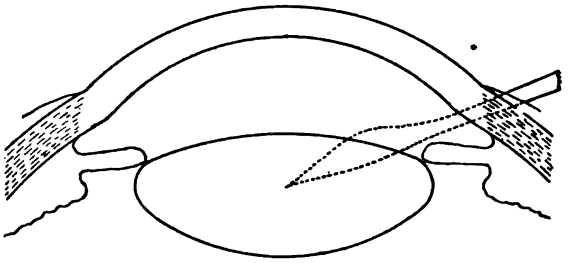
control of ocular movements is obtained, and this can be supplemented by holding firmly the needle when it has been introduced through the sclerocorneal coat. Only in very exceptional cases should one proceed to operate without the strong probability of complete steadiness of the eyeball. But the importance of this may be somewhat modified by the condition of the lens to be dealt with. I have not encountered serious difficulty or complications from movements of the globe during the operation, which has generally been done under local anesthesia; but it is a matter in which the individual operator must have full latitude of choice, and a decision is to be reached after careful consideration of the individual case.

The first step, the introduction of the needle, is still described in the majority of text-books as to be done through the clear cornea. Fifteen years ago, when the writer urged entering the knife-needle through the vascular limbus for the discission of pupillary membranes, on account of certain mechanical disadvantages, he did not suggest avoidance of the clear cornea when doing discission of the lens. The needle introduced to break up the crystalline lens does not need to make the same free sweep as to divide a pupillary membrane. So it should not do as much damage to the corneal tissue about the point of penetration. But even for discission it is safer to introduce the needle through vascular tissue, and this plan I have followed of late years.

Among fourteen of the more complete works on diseases of the eye or on ophthalmic operations, issued within the last five years, examined with reference to this point, only five writers, Parsons, Beard, Callan (Wood's "System of Ophthalmic Operations"), Bach (Axenfeld's "Lehrbuch"), and de Schweinitz (as a preferred alternative method) clearly recommend this entering of the needle through the vascular limbus.

The puncture is commonly made through the outer or

outer lower portion of the limbus, where there will be the greatest freedom of movement and the least interference with it by the orbital margin. Starting from one-half to one millimeter back from the clear cornea, the needle should be entered almost parallel to the plane of the iris until the point has passed the edge of the pupil. Then with the back or flat of the needle toward the iris the point may be depressed until it touches the capsule, and then pushed directly forward as near as may be to the center of the lens nucleus. After this direct forward thrust it is directly withdrawn. The position of the needle at the completion of the forward thrust is shown by the dotted lines in the accompanying figure.



Position of the needle at the completion of the forward thrust.

This constitutes the first needling for a lens not previously opened by trauma, or completely opaque and noticeably shrunken. If any large amount of clear lens substance be present, it is important not to make the first attack any more radical. This constitutes what Kuhnt has well called a "test discission." It generally starts the process by which the lens is to be removed, and it tests the probable reaction of the eye to such operative interference. If the needle be narrow and directly withdrawn, the capsule may close in a young child, and the lens remain clear. I have seen this occur where, immediately after the needling, the path of the needle could be distinctly seen to pass through the whole

thickness of the lens. On the other hand, I have seen complete absorption of the previously clear lens follow one needling in a girl of eighteen, where the needle, 1¼ mm. wide, was thrust into the center of the nucleus and then given a half-turn before withdrawal. Between these extremes any grade of effect may be produced.

It is expected that the first operation will carry the lens somewhat toward absorption, but it is well to regard it rather as a test and a preparatory procedure than to expect it to produce a definite considerable removal of the lens substance.

The procedure thus described differs from that of Kuhnt and some others in that the discission is not confined to the anterior cortex, but attempts to open a channel for the aqueous to the very center of the nucleus. This is not of great importance in young children, who have no nucleus perceptibly firmer than the cortex. But in older children and in adults the invasion of the nucleus is important. Where a firmer nucleus is present it offers the obstacle which makes removal of the lens by absorption slow and difficult. So long as soft cortex remains its absorption goes on satisfactorily. But when the cortex is gone there may remain a nuclear mass that will last indefinitely, unless it has been broken up with the needle. During the early stages of the process, while the lens capsule is still filled with the lens substance, it is not difficult to incise the nucleus and start it on the way to absorption. But after the cortex has been absorbed and the nucleus lies loose in the capsule, it is very difficult to divide it or break it up with any form of knife-needle. Some firm nucleus may exist early in childhood, and on this account it is better to have the first thrust of the needle pass into the nucleus and start the process of disintegration.

The extent of mechanical disorganization of the lens to be aimed at in a second needling must depend somewhat on the

effects of the first. If the first operation caused a marked swelling and general opacity of the lens, and time has been allowed for any extruded lens substance to be dissolved, and the bulging of the point of opening in the capsule to subside somewhat, a more decided effect may safely be attempted.

In the second operation it is well to aim chiefly at disintegration of the nucleus without much extension of the opening in the capsule. The point of entrance is practically the same as for the first needling; the needle is carried well into or through the nucleus, and is turned and made to cut up and down so that the nucleus may be broken up into several fragments. If the opening into the capsule is enlarged, it should be in the direction of the center of the pupil. At this stage the capsule is still friable and cuts easily. Lens swelling tends to enlarge the opening and so increase the effect of the operation. The ideal procedure at this stage should aim at securing the greatest disintegration of the lens inside of the capsule. Only after such disintegration has been fairly completed is it safe to have large masses of lens substance fall into the anterior chamber.

If, on the other hand, the effect of the first needling has been comparatively slight, and yet distinctly noticeable, we are justified in assuming that the factors producing lens absorption are such, in this particular eye, that more mechanical effect must be produced by the operation than would be safe in some other eyes. If, therefore, a sufficient time (one to two months) has been allowed to elapse between operations, one may proceed in such an eye to stir up the nucleus almost as freely as he would in an eye that had made more decided progress.

After such a second operation it is commonly best to wait until very decided shrinking of the lens has occurred, and certainly until the eruption of lens matter through the opening in the capsule has entirely ceased. Subsequent needlings

must be planned to meet the conditions of the particular lens. After the lens has shrunken one-half in bulk (the remaining substance probably not representing more than one-sixth to one-tenth of the original lens) one may proceed to do an operation that will fully open both anterior and posterior capsules. In young people, to get a permanently clear pupil, the anterior capsule must be removed from the pupillary area, and even the posterior capsule may prevent the best vision.

With regard to the needle to be used in such operations: Any of the straight needles will answer. For the first operation the Bowman lance-head stop-needle is quite satisfactory; the Knapp needle is equally so. I rather prefer these to the Ziegler knife-needle, because the greater breadth of the blade allows the necessary opening to be made by the simple thrust and withdrawal. The width of blade entering the lens should be 1 to 1.5 mm. In the final operation the knife-needle of the Hays-Ziegler type is distinctly preferable. It has less tendency to push the membrane aside when it comes to making a division of the capsule.

In the operation of discission, safety and complete success are attained by allowing sufficient time. In young children three operations will usually be sufficient, but twice that many may sometimes be better, where the process starts very slowly. In older patients the larger number is often required. Even for young children it is best to start with the understanding that it may take six months to effect the desired result. In older persons it is better to allow a year.

Clearly the method is not one to be advised for patients living at a distance, or who must be rid of the cataract at a certain definite time. But for those within easy access and able to wait it may often be the best method and one causing the least inconvenience or disturbance of ordinary occupations. After needling, the other eye should not be used for exacting work during the period of reaction. But it need

not be closed, and even the eye operated on is better freed from all dressings within twenty-four hours.

The usefulness of the method is not so restricted by age as has frequently been supposed. I have had two patients successfully treated by needling of complete cataract after the age of forty; and up to that age it is to be considered a possible therapeutic resource. Under thirty, if not excluded by lack of the time required, it is a method always to be considered.

DISCUSSION.

DR. ROBERT SATTLER, Cincinnati: For discission and lens removal in younger subjects it has been my plan to proceed along slightly different lines from those mentioned by Dr. Jackson. Formerly a preliminary capsule laceration with a knife-needle passed through the vascular limbus was followed two or three days subsequently, after lens swelling was well in progress, by a more liberal opening incision on the cornea, midway between its center and periphery, on the temporal side. This incision is made with a broad lance, and with a Daviel's spoon partial excavation of the softened and opaque lens substance is now easily effected and repeated until complete removal of the lens is accomplished. Recently I have followed the suggestion of Homer Smith of making a preliminary larger or more liberal capsulotomy, and then follow this, at the opportune time after an interval of one or several days, by the procedure just mentioned. In my experience this leads to safer and better cosmetic and visual results.

DR. S. LEWIS ZIEGLER, Philadelphia: I can indorse Dr. Jackson's technic in performing these operations on soft cataract. I must say, however, that I do not always limit myself to making the puncture through the periphery, as I sometimes puncture the cornea if the indications favor that technic. In other words, I do not think the corneal route is so dangerous that it must invariably be avoided. I always use my own knife-needle, probably because I am more accustomed to it. I do not think that the shorter stop-needle of Bowman is as useful in this class of cases. As a

rule, I make the ordinary V-shaped incision in the anterior capsule, but not so large as I would make it in performing a capsulotomy. I generally make a series of three operations at intervals of three weeks apart. The first operation is a simple capsular incision or cystotomy. I make a similar incision for the preliminary cystotomy of the Homer Smith operation. The second operation divides the nucleus, if that has not yielded to the first operation. The third and final operation makes a V-shaped incision through the posterior capsule and opens up the cortical débris that has been left behind.

For fixation in children, if we do not wish to employ a general anesthetic, I think there is nothing so useful as a small horseshoe-shaped forceps. You can fix with these perfectly and the little patient cannot get away from you, providing the nurse holds the head. I do not think it is possible to do any harm to the eye with these forceps, and I prefer this method to etherizing whenever it can be utilized. If cocain is applied, the pain is practically nil, and the operation is finished in a few minutes.

Discission of the mature cataractous lens is not practised as often as other methods, but I think sometimes in older persons it would be wiser, as Dr. Jackson has mentioned, to do this operation. I had a case recently where I was convinced that this was the operation of choice on account of choroidal hemorrhage in the other eye. I thought it was wiser to undertake, even at an advanced age, a discission of this type rather than to risk another visual disaster.

DR. E. E. JACK, Boston: I would like to speak of an experience in doing a discission on a congenitally dislocated lens with zonular cataract in a boy of ten. Three separate discissions, each one more thorough than the preceding one, resulted in nothing but opaque spots in the capsule, the lens substance being apparently totally unaffected. I know of no other explanation for this than that the lens was partly bathed in vitreous.

DR. EDWARD JACKSON, Denver: I intended to refer only to discission that is dependent upon absorption for the removal of the lens. I think the point that Kuhnt dwells upon in his last paper of the test discission is an important

one. It is impossible to know before operating what will be the reaction in a particular case. About a year ago I had two young women, sixteen to eighteen years of age, respectively. In one of them complete absorption of the lens followed the first needling, which consisted of the introduction of a Bowman stop needle into the center of the lens, and withdrawing it without any additional cut in the capsule. In the other case the first needling was just about as free, but was followed by no perceptible effect. The advantage of the rather broad needle, 1 to 1.5 mm., is that you can get a sufficient opening without moving it laterally to enlarge the opening made by piercing the capsule. For the later operations, where you want to cut, the narrow needle I think is in every way preferable.

TWO CASES OF SIMPLE CHRONIC GLAUCOMA TREATED BY IRIDOTASIS.

DAVID HARROWER, M.D.,
Worcester, Mass.

In the *Archives of Ophthalmology*, volume xl, No. 4, page 405, I read a most interesting account of Johan Borthen's operation for the treatment of glaucoma by iridotasis. This, according to Borthen, was a decided step forward from the operation of Holth, who in 1907 reported an operation intended to reduce tension of eyes in glaucoma. This operation he called iridencleisis. This was intended to produce a fistulous opening between the anterior chamber and the subconjunctival lymph-channels by incarcerating the incised iris in the scleral keratome incision, and allowing the conjunctival flap to heal over it. Borthen says:

"I have always doubted the advisability of incising the iris and making a flap for incarceration, believing this part

Conjunctival bleb after iridotasis.

of the operation to be unnecessary, and convinced that the same effect could be produced by inclusion of a fold of the iris, allowing the posterior surface to coalesce with the subconjunctival tissues, assuring a position of the sphincter external to the section, and with this free drainage. This modification has the advantage of avoiding a step of the operation, incision of the iris, which requires skilful technic and a good assistant to hold the conjunctival flap down on the cornea during iridotomy. If reduction of tension depends on filtration, as I believe, and a fistulous communication is not a *sine qua non*, this modification of mine would afford a simple and effectual substitute for Holth's rather complicated procedure. . . . The operation is performed as follows: The conjunctiva is grasped with fine straight forceps about 10 mm. back of the upper limbus and a cut 2 to 3 mm. long made in the raised conjunctival fold with ordinary iris-scissors. The scissors are then carried toward the limbus, dissecting a conjunctival flap and keeping as near to the scleral surface as possible in order to include a large amount of subconjunctival tissue in the flap. Care must be taken to avoid fenestrating the conjunctiva near the limbus, as this would not only expose the incarcerated iris to infection, but interfere with filtration as well. The globe is now held with fixation forceps, and the lance-knife, with a stop, introduced about 1 mm. back of the sclero-corneal margin, and carried down through the anterior chamber until the section is 4 to 5 mm. long. The conjunctival flap can be made by means of the lance-knife when making the incision, but dissection with scissors insures the inclusion of subconjunctival tissue in the flap, and I believe this is a matter of practical importance for filtration and the formation of subconjunctival bleb. The iris is now grasped at the sphincter with the iris forceps, taking up a fold 1 to 2 mm. wide, drawn out through the section and left there. . . . A drop of atropin, instilled ten minutes before

operation, will insure the permanency of the prolapse, and does not cause increased tension, as I have observed."

The only modification I made in this operation, which is a very simple one, is having my assistant grasp the edge of the conjunctiva, and hold it up straight at right angle to the sclerocorneal surface. Then with a keratome make the incision, which I think would be more difficult when the upper part of the cornea is covered with the conjunctiva. One can thus see the knife during the whole incision.

The results that Borthen reports following his cases for a period of from two or three months to two years are remarkable. I have only had an opportunity to do two of these for chronic glaucoma. I have seen no others reported, but the results have been so striking that I wish to draw them to the attention of the members of this Society.

CASE I.—Mrs. M. E., aged sixty, came to me August 14, 1911. The vision of her right eye has been growing dim for the last year or two. She can see simple movements of the hand, the field of vision being very much limited out, up, and in. The disc is cupped. She has not seen well for a long time with this eye. In the left eye V. $=\frac{8}{10}$; with +.75 D. s.⌒+.50 D. cyl. axis 160° $=\frac{8}{10}$. The vision in this eye has been growing dim lately. The disc is cupped. The field limited up and out. The tension is +. I gave her 1 per cent. solution of pilocarpin to use twice a day.

August 29th, vision has improved to $\frac{10}{10}$, partly, with a glass.

September 30th, is about the same. Pilocarpin continued.

October 11th, is doing nicely. I then gave her aspirin gr. v, three times a day.

November 14th, I gave her a reading glass and repeated the aspirin.

February 13, 1912, her vision is not quite so good—$\frac{8}{10}$ with correcting glass.

March 15th, $\frac{10}{10}$, partly, with correcting glass.

May 17th, $\frac{8}{10}$. Field has diminished. Operation advised.

June 15th, following out Borthen's instruction as near as I could, I did an iridotasis. I found a little difficulty in getting the conjunctiva out of my way, but with my assistant holding this with a pair of forceps I succeeded very well in

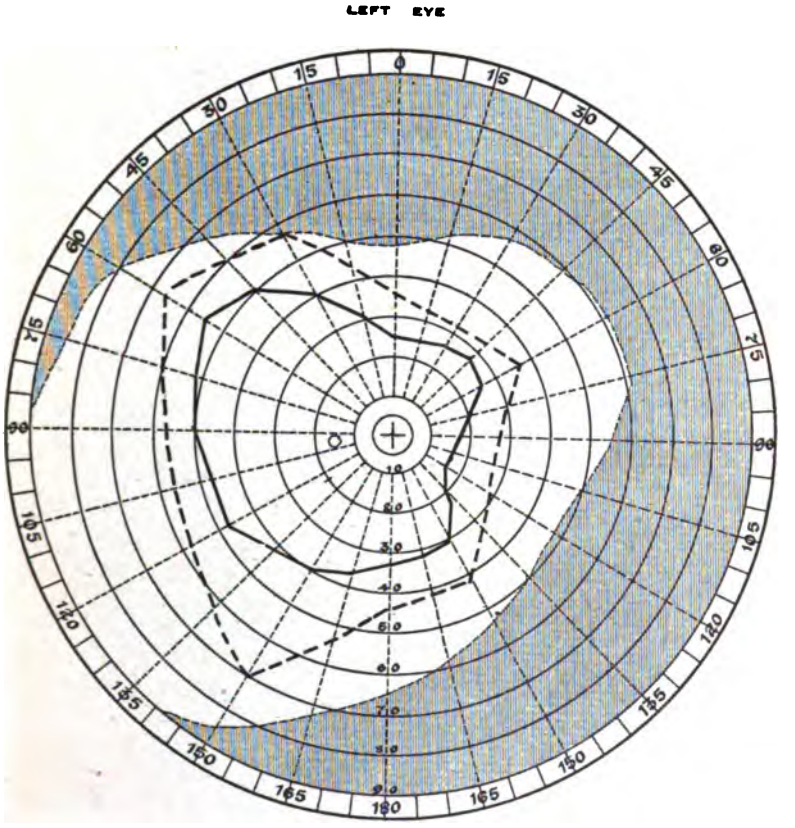


Fig. 1.—Solid line, field before operation. Dotted line, field nearly a year afterward.

making my cut with a keratome. This patient had no trouble, no irritation. The whole wound healed very kindly, but with correcting glasses her vision had dropped on August 1st to $\frac{5}{10}$.

September 12th, it was still $\frac{5}{10}$.

I saw her December 18, 1912, and her vision was $\frac{5}{10}$. Her field had enlarged (Fig. 1).

I also saw her on April 17th. Vision with +.75 s. ⌒ +.50 cyl. axis 90° = $\frac{8}{10}$ partly; with +5.50 s., combined with

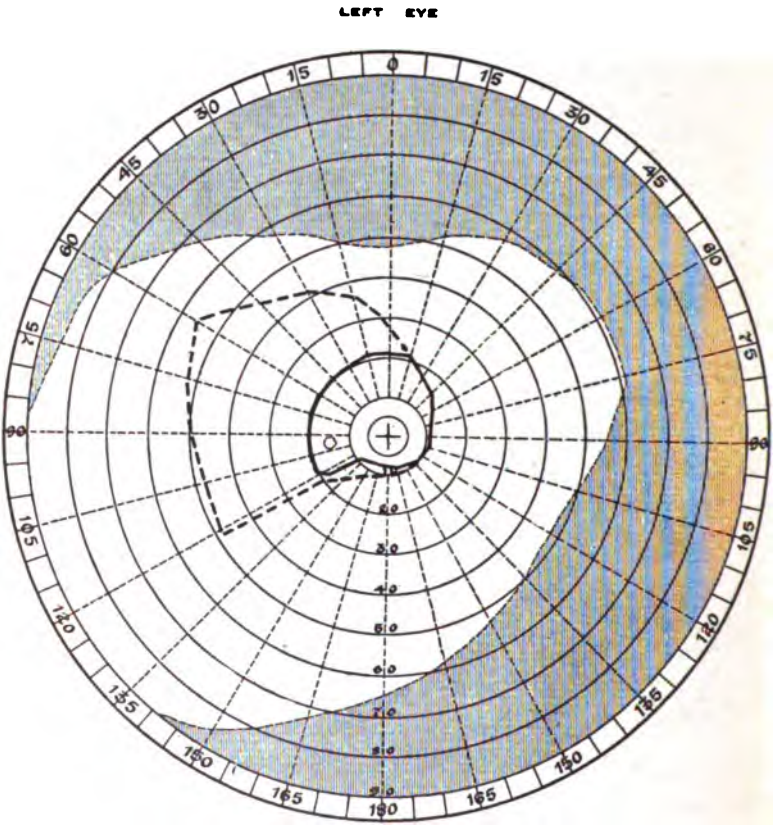


Fig. 2.—Solid line, field before operation. Dotted line, field nearly a year afterward.

a cylinder, she could read Jaeger 3. The tension has been normal since the operation.

CASE II.—Through the courtesy of my colleague, Dr. Lovell, on July 17th I saw Mr. O. G., aged fifty-nine. He

has had chronic glaucoma for six months or more. The right eye is simply perception of light, deep cupping of nerve, and tension +3. The right eye is $\frac{8}{10}$, partly, central vision. Tension +2.

July 23d, assisted by Dr. Lovell, I did an iridotasis. This man went along beautifully with the result of $\frac{8}{10}$ vision. The field, as you will see, on July 17th was very limited.

On August 6th, about three weeks after the operation, you can see the large increase in nearly all directions. The vision has increased to $\frac{10}{10}$, practically (Fig. 2).

Of course, this does not prove a great deal, as one ought to have more than two cases to report. Still, these two cases have been exceedingly gratifying, and I hope, as I see more cases of chronic glaucoma, I will have an opportunity to perform this operation oftener, and at some future time to be able to report another series.

DISCUSSION.

DR. EMIL GRUENING, New York: The operations of iridotasis and iridencleisis are intentional incarcerations of the iris between the lips of the scleral wound. Such incarcerations have occurred in my practice without my intention, and to my great dissatisfaction. It is not always possible to free the columns of the coloboma. I consider the occurrence of an incarceration unpreventable in some cases, but never desirable. It is true that temporary and even permanent good visual results may be obtained in spite of the inclusion of the iris; it can never be an ideal result and should not be introduced as a method. Clean iridectomy, combined with sclerectomy according to Lagrange, has given me good results.

DR. S. LEWIS ZIEGLER, Philadelphia: I do not wish to speak in criticism of Dr. Harrower's operation, or of his excellent result, but I think that incarceration of the iris is a very dangerous procedure, which has been proposed by Critchett and others and sooner or later abandoned, because it produced iridocyclitis in the incarcerated eye and sympathetic iritis in the other. Although most of us have not seen the bad effects of this operation because we have not

performed it, I am sure that those of us who have served under the older régime of twenty-five years ago have seen results that were absolutely deterrent. Any incarceration of the iris which is afterward pinched is liable to develop sympathetic ophthalmitis in the fellow eye. In this case, which Dr. Harrower has described, the photograph shows that he has secured a filtering cicatrix not unlike the Lagrange operation. Possibly there is some conjunctiva incarcerated. The moment that the conjunctiva heals and the scleral wound closes on the iris there is danger, just as there is in a corneal incarceration. I do not see why we could not, as I suggested some years ago, incarcerate a tongue of conjunctiva in the scleral wound and thus secure a filtering cicatrix that will be equally efficient and less dangerous.

DR. W. B. MARPLE, New York: I congratulate Dr. Harrower heartily on the most excellent results which he has obtained by this operation. It seems to me, however, that we can get equally as good results in a more satisfactory way.

You all remember that one of Herbert's earlier operations was the formation of the subconjunctival fistula, but after a year or two he gave this up on account of the dangers from sympathetic inflammation from the prolapsed iris. The author of the paper on iridotasis, John Borthen, developed it from that of iridencleisis of Holth. The latter first published a description of this operation in 1907, but, not being satisfied with its results, he gave it up, and two years later published the results of his new operation, sclerectomy with a punch. In these various operations history is oftentimes made so fast that it is difficult to keep up with the procession. Many of you no doubt have had cases of chronic glaucoma where an iridectomy was followed by incarcerated iris. From the surgical standpoint these cases have not pleased me, but filtration was secured, and the tension remained normal. But a method which aims to produce a prolapsed iris does not appeal to me, especially as we have today other operations which result in lowering the tension without such prolapse.

DR. S. D. RISLEY, Philadelphia: I always hear with interest the experience of a colleague with any procedure which

commends itself to his judgment. I am here to be taught. I do not rise to discuss Dr. Harrower's experience in the spirit of criticism, but to say that in my experience I have found it wise to avoid incarceration of the iris in the wound; for example, after iridectomies, in the extraction of cataract, etc. I have seen such an accident followed by irritable eyes and a tedious, prolonged, and anxious convalescence. I should, therefore, having these experiences in mind, hesitate in the performance of any operation designed to effect a permanent incarceration of the iris.

DR. SAMUEL THEOBALD, Baltimore: This reminds me of a procedure introduced by Mr. Critchett, Sr., of London, which he called iridodesis. It was done where there was a central corneal opacity, the idea being to obtain a narrow pupil with apex at the margin of the cornea. An incision having been made in the sclerocorneal junction with a broad needle, the iris was seized at the pupillary margin with a blunt hook, drawn out, and about it was tied a fine silk loop. The included portion sloughed, and the iris became adherent to the corneal wound. The immediate result was satisfactory, but the operation was abandoned because, every now and then, a case of sympathetic ophthalmitis resulted. My experience has been very similar to that spoken of by Dr. Gruening and others. My classic iridectomies, whether for inflammatory or simple glaucoma, have been the ones which have proved least satisfactory. The ragged iridectomies, in which incarceration of the iris occurred, and which I felt ashamed of, have afforded the best results. I think that the inclusion of the iris is probably helpful, for, if we get a filtering cicatrix, we keep the tension down.

DR. EDWARD JACKSON, Denver: I think that the point that Dr. Theobald has made is perhaps the most important in reference to this operation. A subconjunctival prolapse of the iris is a totally different thing from one where the iris is exposed outside of the conjunctiva and simply covered with exudate. If the iris is covered by a broad flap of conjunctiva, so that it is quite removed from the superficial wound, the seriousness of a prolapse is in my experience totally different. While I have not attempted to do Borthen's operation, in chronic glaucoma, where it was doubtful whether an

iridectomy would give a good result, I have proceeded to drag the iris into one angle of the wound and cut it off, and then drag it into the other corner and cut it off, leaving the iris caught in each angle of the wound. I think in every one of these cases I obtained a filtering scar and permanent reduction of tension. I am not sure but that it is a more certain way of getting permanent reduction of tension than the Elliott or Lagrange operations. The fact that these latter are clean operations, of course makes them very attractive. But when we put the iris stump into the wound we introduce blood-vessels and lymph-spaces into the wound, where they are more or less permanent. In some cases they go on to permanent dilatation, so that we have done a sort of plastic operation in which the stump of the iris establishes a subconjunctival drainage from the anterior chamber. This may be more permanent than drainage established by a clean hole in the sclera, without introducing vascular tissue to keep up the drainage. In none of the cases in which I have sought to incarcerate the iris have I left it uncut. I removed as much iris as possible, leaving only the stump in the scleral wound.

DR. B. ALEXANDER RANDALL, Philadelphia: It is not always advisable to draw conclusions from pathologic study, since the cases studied are generally the failures; but such investigation of this question of a filtering cicatrix as I have been able to make with the microscope has raised the question whether the external filtering portion is of great importance. Large cystoid cicatrices after cataract extraction seem a cause rather than a preventive of glaucoma. We should have at the Fontana spaces a proper, normal, and sufficient drainage. When we make in iridectomy, or more still in sclerotomy, an incision near the corneal margin, the major part of the gain is in doing away with Descemet's membrane, which never reunites; and studies made, as I admit, on unsuccessful sclerotomies, show that the actual cicatrix is the tightest part of the cornea, and that there is no suggestion of anything like filtration through the scar itself. I remember throwing pictures of this for Dr. Norris upon the screen at our 1887 meeting. The cornea itself was quite loose in texture and was capable, like a corneal mar-

gin, of permitting a good deal of filtration; and I would respectfully raise the question whether our object is not really to do away with the membrane on the interior surface, and the more we can bring that about the more successful we will be.

DR. DAVID HARROWER, Worcester, Mass.: I do not think the gentlemen have all thoroughly understood the operation. In the first place, there is about 10 mm. of conjunctiva to cover the exposed iris; the iris is not cut, it is simply drawn out and left in the wound. In every successful case which Borthen has reported, a total of 97, he reports success in all but several cases of hemorrhagic glaucoma. He does not expose his iris at all. It is covered with his conjunctiva and well covered, and the whole object is to make the filtrating scar. Both of these cases of mine had beautiful filtrating cicatrices, and the tension is normal and everything has gone along beautifully so far. In regard to Dr. Theobald's speaking about Critchett's operation, the cut was made and the iris was brought out and exposed to all infection.

DR. THEOBALD: Not cut.

DR. HARROWER: It sloughs off. I remember the operation very well. I have seen it several times. We do not get an exposed iris for infection; it is all well covered. As far as I can see, these have been perfectly surgically clean. I do not see why that point is raised. It is not to take the place of the Lagrange or Elliott operations, but it is a very simple operation. I have only had these two cases, and I am glad to have an expression of opinion on the inadvisability of it, but I am going to try some more until I see trouble. I wish Dr. Roy were here to speak, as he has had several cases.

DR. SAMUEL THEOBALD: Did you attach the iris in any way to the conjunctiva, and does it remain the same size or does it undergo atrophy in time?

DR. HARROWER: Just the iris is brought in. The sclera does not grow together. The iris atrophies, and the conjunctiva covers it, just as the photograph shows, and remains so. I think the whole claim is that you get a permanent filtering cicatrix with the iris well protected from infection.

FOURTH SERIES OF CASES OF INJURIES FROM FOREIGN BODIES EXAMINED BY THE ROENTGEN RAYS, WITH RESULTS OF OPERATION.

WILLIAM M. SWEET, M.D.,
Philadelphia.

At the meeting of this Society in 1901 I reported a series of 102 cases, and at the meeting in 1909 a series of 282 cases, of injury to the eye from foreign bodies in which the Roentgen rays had been used for diagnosis, and gave the results of operation in the cases in which a foreign body was located in the eyeball or surrounding structures. A second series of 318 cases was published elsewhere in 1906.* In the present communication are reported 280 cases of ocular injury, in 185 of which the substance was found to be lodged in the eyeball or orbit. For the purpose of comparison the 982 cases are embraced in the following statement:

Position of Body.	First Series.	Second Series.	Third Series.	Present Series.
In the eyelid	1	2	0	0
In the lens	3	14	16	7
In the iris or posterior chamber	1	4	4	2
In the ciliary region	24	27	12	19
Near the equator	21	69	52	51
Posterior part of eyeball	12	46	48	73
In the orbit	3	11	25	33
No body shown by *x*-rays	37	145	125	95
	102	318	282	280

In the above subdivision of the vitreous chamber the "ciliary region" includes all cases in which the body was situated in or close to the ciliary body; the equatorial region, all bodies situated at the equator or in an area 3 mm. in

* Sect. on Ophth., A. M. A., 1906.

front or 3 mm. behind it; while the third division includes all cases in which the body was in the posterior part of the globe. Of the total 982 cases of injury, 812 were caused by particles of iron or steel, 60 by copper, brass, or other non-magnetic metal, 73 by shot, 32 by glass, and 5 by coal.

The right eye was injured in 452 cases and the left in 522 cases, and both eyes in 8 cases.

The following figures give the ultimate result in the 65 cases in the first series, the 173 in the second series, and the 157 in the third series in which a foreign body was located in the eyeball or surrounding tissues, with details of the 185 cases in the present group:

	First Series.	Second Series.	Third Series.	Present Series.
Eyeballs enucleated:				
Extraction not attempted or failed	14	23	19	45
Extraction successful—enucleation later	10	28	39	20
Eyeballs saved:				
No operation attempted	7	11	4	5
Extraction failed	2	4	9	7
Bodies in eyelid or orbit	4	9	17	23
Extraction successful				
Vision $\frac{6}{12}$ or better	7	20	17	20
Vision $\frac{6}{15}$ to $\frac{6}{60}$	4	13	11	16
Fingers or hand movements, etc.	0	7	12	5
Good light projection	9	27	15	17
Light perception	6	21	9	15
No light perception—eye normal size	0	6	2	5
Eyeballs shrunken	2	4	3	7
No bodies shown by *x*-rays	37	145	125	95
Total	102	318	282	280

Most of the patients examined came to the Wills Hospital, Philadelphia, were referred to me for *x*-ray localization, and I am under obligations to the surgeons who treated the cases for aid in determining the ultimate result as to vision. In instances in which the patients did not return to the hospitals after extraction for subsequent examination and treatment, record of the condition of the eye and the vision was secured by visits to them at their homes or places of labor in this city or by correspondence and examination by

physicians in the cities in which the patients lived. In some cases it has been impossible to locate individuals.

EYEBALLS SAVED.—In the first series extraction was successful and the eyeballs saved in 28 cases, 7 with vision better than $\frac{6}{12}$ and 21 with vision less than $\frac{6}{12}$. In the second series the steel was successfully removed in 98 cases, 20 with vision better than $\frac{6}{12}$ and 78 with less than $\frac{6}{12}$. In the third series extraction succeeded in 69 cases, 17 with vision better than $\frac{6}{12}$ and 52 with less than $\frac{6}{12}$. In the present series extraction was successful in 85 cases, 20 with vision better than $\frac{6}{12}$, and 65 with less than $\frac{6}{12}$. In many cases vision could be improved by the removal of the existing cataract.

In Tables I and II are given the details of the present series of cases, and include those in which the body was in the orbit, those in which the body was removed from the eyeball, and those in which extraction failed or was not attempted, excluding cases of enucleation.

TABLE I.—EYES SAVED—DOUBLE PERFORATION—STEEL.

CASE.	SURGEON.	EYE.	SITUATION OF WOUND.	SIZE OF BODY.	TIME BETWEEN INJURY AND EXAMINATION.	TIME BETWEEN EXAMINATION AND LAST REPORT.	VISION.	REMARKS.
702	Posey.	L.	C.	3 x 2	2 days.	1 year.	Good L. P.	4 mm. back of ball.
707	Zentmayer.	R.	S.	6 x 3	5 days.	4 yrs.	No L. P.	20 mm. back of ball.
721	Sweet.	L.	C.	2 x 1	3 days.	3 yrs.	Good L. P.	Cataract.
736	Pontius.	R.	L.	2 x 1	6 days.	1 year.	Good L. P.	Nasal side orbit.
743	Zentmayer.	R.	C.	2 x 1	7 days.	4 yrs.	Good L. P.	Cataract.
744	Posey.	L.	C.	3 x 2	6 days.	2 mos.	L. P.	2 mm. back. Cataract.
755	Taylor, L. H.	L.	C.	4 x 2	1 mo.	4 mos.	L. P.	15 mm. back of ball.
764	Fisher.	R.	C.	3 x 1	5 days.	3 mos.	No L. P.	Nasal side orbit.
781	Ziegler.	L.	C.	3 x 2	4 days.	2 mos.	6/12	Lens cureted.
794	Risley.	L.	L.	2 x 2	12 days.	3 mos.	Mov. obj.	Nasal side orbit.
812	Radcliffe.	R.	C.	2 x 1	5 days.	3 mos.	6/6 partly.	Lens cureted.
898	Sweet.	R.	C.	2 x 1	5 days.	2 mos.	Good L. P.	Cataract.
902	Posey.	R.	S.	3 x 2	4 days.	3 mos.	Imp. L. P.	Vitreous opacity.
906	Ziegler.	L.	C.	2 x 1	1 year.	1 mo.	Imp. L. P.	Cataract.
916	Posey.	L.	C.	3 x 1	3 days.	2 mos.	Good L. P.	Cataract.
961	Zentmayer.	R.	S.	3 x 1	2 days.	2 mos.	Imp. L. P.	Cataract.
945	Pontius.	R.	C.	3 x 2	2 days.	1 mo.	Imp. L. P.	Cataract.
				DOUBLE PERFORATION—SHOT.				
706	Tybout.	L.	S.	Shot.	1 day.	4 yrs.	6/6	..
713	Zentmayer.	L.	L.	Shot.	6 days.	1 mo.	L. P.	..
842	Schwenk.	R.	L.	Shot.	1 mo.	2½ yrs.	L. P.	..
845	Ziegler.	R.	S.	Shot.	2 mos.	6 mos.	Imp. L. P.	..
848	Risley.	L.	S.	Shot.	8 wks.	1 mo.	Imp. L. P.	..
851	Fisher.	R.	S.	Shot.	3 wks.	2 yrs.	Imp. L. P.	..

TABLE II.—EYES SAVED—PRESENT SERIES: STEEL AND COPPER.

Case.	Surgeon.	Eye.	Situation of Wound.	Size of Body.	Time Between Injury and Extraction.	Time Between Injury and Last Report.	Vision.	Remarks.
Lens or Posterior Chamber:								
739	Sweet.	L.	C.	1 x 1	1 mo.	4 yrs.	6/30	In posterior chamber, other eye lost.
742c	Moore.	L.	C.	1 x 1	7 wks.	2 yrs.	6/12	Capsular opacity.
763	Radcliffe.	R.	C.	½ x ½	10 mos.	3 yrs.	6/12	Lens cureted.
772	Fisher.	L.	C.	2 x 2	12 days.	1 year.	6/12	Capsular opacity.
843	Ziegler.	L.	C.	1 x ½	2 wks.	3 yrs.	6/9	Lens cureted.
856	Fisher.	R.	C.	1 x ½	6 mos.	2 yrs.	6/22	Capsular opacity.
919	Schwenk.	L.	C.	¼ x ½	2 wks.	2 yrs.	6/6	Lens cureted.
925	Sweet.	L.	C.	3 x 2	1 day.	1 year.	6/9	In posterior chamber.
927	Risley.	L.	C.	2 x 1	2 mos.	1 year.	6/10	Lens cureted.
Ciliary Region:								
709	Radcliffe.	L.	C.	6 x 4	5 days.	4 yrs.	No L. P.	Shrunken.
737	Pontius.	L.	L.	3 x 2	30 days.	6 mos.	Imp. L. P.	Cataract.
740	Radcliffe.	L.	S.	5 x 3	2 wks.	3 mos.	No L. P.	Eye quiet.
805	Moore.	L.	S.	3 x 1	1 wk.	2 yrs.	6/18	Choroid degeneration.
809	Ziegler.	L.	C.	1 x 1	10 wks.	3 yrs.	6/12	Lens cureted.
827	Fisher.	R.	C.	2 x 1	5 days.	10 mos.	6/18	Capsule needled.
861	Chance.	R.	L.	2 x 1	4 mos.	2 yrs.	Good L. P.	V. =6/9 for 1½ yrs., then cataract.
874	Oliver.	L.	S.	2 x 1	1 day.	1 year.	5/15	Cataract.
888	Radcliffe.	R.	S.	2 x 1	2 mos.	2 yrs.	No L. P.	Shrunken. Extraction failed.
903	Schwenk.	L.	C.	2 x 1	6 days.	2 yrs.	6/60	Lens cureted.
914	Sweet.	R.	C.	1 x 1	5 days.	1½ yrs.	L. P.	..
937	Radcliffe.	R.	C.	1 x 1	4 days.	1 year.	L. P.	..
941	Sweet.	R.	S.	1 x 1	5 days.	6 mos.	6/30	Choroid degeneration.
948	Ziegler.	R.	C.	2 x 2	3 days.	1 year.	Hand move.	Capsular opacity.
952c	Risley.	L.	C.	1 x 1	3 mos.	3 mos.	No L. P.	Shrunken. Extraction failed.
Equator:								
704	Oliver.	R.	C.	2 x 1	22 days.	4 yrs.	Good L. P.	Cataract.
711	Sweet.	R.	S.	3 x 1	11 days.	4 yrs.	6/9	Steel floated in vitreous.
716	Sweet.	L.	S.	3 x 2	1 day.	6 mos.	L. P.	Retina detached.
718	Ziegler.	L.	C.	3 x 1	2 days.	4 yrs.	No L. P.	Shrunken.
720	Sweet.	R.	C.	4 x 1	3 days.	1 year.	L. P.	Cataract.
729	Chance.	R.	C.	½ x ½	2 mos.	2 mos.	L. P.	Extraction failed.
731	Ziegler.	L.	L.	3 x 2	2 days.	3 yrs.	6/6 partly.	Lens clear.
749	Ziegler.	R.	L.	4 x 2	6 days.	3 yrs.	6/22	Vitreous hazy.
752	Sweet.	R.	C.	3 x 2	5 wks.	2 yrs.	L. P.	Cataract.
757	Posey.	R.	S.	3 x 2	1 day.	2 yrs.	No L. P.	Eye normal size.
759	Shoemaker.	L.	C.	3 x 1	2 days.	3 mos.	L. P.	Cataract.
760	Oliver.	L.	S.	3 x 2	2 wks.	3 yrs.	No L. P.	Shrunken. V.=6/18 for 6 months.
774	Risley.	L.	S.	1 x 1	3 mos.	1 mo.	L. P.	Stone. Extraction not attempted.
780	Forst.	R.	C.	3 x 1	1 mo.	1 year.	Imp. L. P.	Cataract.
784	Pontius.	L.	C.	1 x 1	8 mos.	3 yrs.	Imp. L. P.	Cataract.
787	Schwenk.	R.	C.	1 x 1	10 mos.	1 mo.	Good L. P.	Cataract.
792	Fisher.	R.	S.	2 x 1	3 days.	3 yrs.	6/15	Lens clear.
810	Harbridge.	L.	C.	1 x 1	6 days.	3 yrs.	Good L. P.	Cataract.
830	Sweet.	R.	S.	2 x 1	7 yrs.	3 yrs.	Fingers 3′	Vitreous hazy.
852	Pontius.	R.	S.	3 x 2	5 days.	2 yrs.	6/60	Choroid degeneration.
859	Pontius.	L.	C.	6 x 4	2 days.	3 mos.	No L. P.	Shrunken.
868	Zentmayer.	R.	C.	1 x 1	8 mos.	1½ yrs.	6/9	Capsule needled.
884	Pontius.	R.	C.	2 x 1	3 yrs.	2 yrs.	Hand move.	Capsular cataract.
889	Risley.	L.	C.	2 x 1	9 days.	6 mos.	L. P.	Cataract.
909	Pontius.	L.	L.	2 x 2	10 days.	2 yrs.	No L. P.	Eye normal size.
924	Sweet.	L.	C.	3 x 1	3 mos.	3 mos.	Imp. L. P.	Retina detached before operation.

C=Copper.

TABLE II.—EYES SAVED.—PRESENT SERIES: STEEL AND COPPER.—(*Concluded.*)

CASE.	SURGEON.	EYE.	SITUATION OF WOUND.	SIZE OF BODY.	TIME BETWEEN INJURY AND EXTRACTION.	TIME BETWEEN INJURY AND LAST REPORT.	VISION.	REMARKS.
928c	Ziegler.	R.	C.	1 x 1	4 mos.	1 mo.	L. P.	Extraction not attempted.
929	Risley.	R.	C.	2 x 1	3 mos.	1 mo.	L. P.	Cataract.
938	Sweet.	R.	S.	3 x 1	1 year.	1 year.	L. P.	Vitreous opacity.
965	Hansell.	L.	S.	3 x 2	2 days.	1 year.	No L. P.	Shrunken.
POSTERIOR PART OF EYE:								
701	Van Pelt.	R.	C.	3 x 2	6 days.	3 yrs.	Imp. L. P.	Retina detached.
705	Posey.	L.	S.	3 x 1	1 mo.	1 mo.	No L. P.	Extraction failed. Refused enucleation.
708	Sweet.	R.	S.	3 x 2	3 days.	4 yrs.	6/12	Cataract.
747	Radcliffe.	L.	C.	3 x 1	4 days.	3 yrs.	Imp. L. P.	Slightly shrunken.
750	Sweet.	L.	C.	3 x 2	4 days.	3 yrs.	6/60	Capsular cataract.
751	Pontius.	L.	L.	2 x 1	6 days.	1 mo.	Good L. P.	Cataract.
754	Sweet.	L.	S.	6 x 3	5 days.	4 yrs.	Imp. L.P.	Extraction failed.
761	Dennis.	R.	C.	4 x 1	18 days.	3 yrs.	2/200	Extraction failed.
766	Radcliffe.	R.	S.	8 x 3	4 mos.	3 yrs.	No L. P.	Slightly shrunken.
769	Oliver.	L.	S.	4 x 1	2 days.	4 yrs.	Good L. P.	Cataract.
770	Shannon.	L.	C.	2 x 1	4 days.	3 yrs.	6/6 partly.	Lens needled.
771	Posey.	R.	L.	5 x 2	2 days.	3 yrs.	L. P.	Cataract.
785	Berens.	R.	C.	1 x 1	2 days.	3 yrs.	Good L. P.	Cataract.
788	Posey.	L.	C.	1 x 1	6 mos.	3 yrs.	L. P.	Extraction failed.
790	Shoemaker.	R.	C.	1 x 1	3 days.	1 year.	L. P.	Cataract.
794	Risley.	L.	L.	2 x 2	12 days.	6 mos.	L. P.	Cataract.
795	Risley.	L.	L.	2 x 1	6 days.	3 yrs.	6/6	..
815	Ziegler.	L.	C.	3 x 2	12 days.	1 year.	6/18	Lens cureted.
817	Fisher.	L.	C.	2 x 1	2 days.	2 yrs.	Fingers 1'.	Cataract.
777	Sweet.	L.	S.	4 x 1	1 day.	3 yrs.	6/6	..
819	Schwenk.	R.	C.	4 x 2	5 days.	9 mos.	Good L. P.	Cataract.
822	Bromley.	R.	S.	2 x 1	4 days.	2 yrs.	5/12	Retinal detachment.
826	Schwenk.	R.	C.	2 x 1	5 days.	2½ yrs.	No L. P.	Choroid exudate, infiltrated cornea.
829c	Fisher.	R.-L.	C.	2 x 1	2 wks.	2 mos.	Imp. L. P.	No operation.
831	Posey.	L.	C.	1 x 1	5 days.	2½ yrs.	Good L. P.	Cataract.
835c	Oliver.	L.	C.	1 x ½	4 days.	1 mo.	Imp. L. P.	Extraction not attempted.
841	Pontius.	R.	L.	4 x 2	10 days.	3 yrs.	Fingers 3'.	Vitreous hazy.
846	Oliver.	L.	L.	2 x 2	2 days.	2½ yrs.	6/18	Choroid. degeneration.
849	Reber.	R.	C.	3 x 2	2 days.	1 year.	Good L. P.	Cataract.
860	Posey.	R.	C.	2 x 1	2 days.	6 mo.	6/30	Capsular cataract.
867	Risley.	L.	S.	1 x 1	4 days.	2 mo.	L. P.	Extraction failed.
869	Fisher.	R.	S.	3 x 2	2 days.	3 mos.	6/6	..
876	Ziegler.	R.	S.	1 x ½	3 days.	1 mo.	6/9	Vitreous hazy.
877	Radcliffe.	L.	C.	1 x ½	10 days.	2 yrs.	15/200	Choroidal atrophy.
878	Fisher.	L.	C.	5 x 2	4 days.	2 yrs.	Good L. P.	Capsular cataract.
879	Fisher.	R.	C.	5 x 1	3 days.	2 yrs.	6/6	Lens cureted.
882	Rhode.	L.	C.	5 x 1	9 days.	1 year.	L. P.	Cataract.
907	Sweet.	L.	C.	8 x 3	2 days.	1½ yrs.	No L. P.	Eye quiet.
930	Sweet.	R.	C.	4 x 2	40 yrs.	..	No L. P.	Extraction not attempted. Shrunken.
934	Shoemaker.	R.	C.	3 x 1	6 yrs.	15 mos.	Good L. P.	Cataract.
936	Fisher.	L.	C.	3 x 2	3 yrs.	8 mos.	6/60	Capsular cataract.
939	Sweet.	R.	S.	2 x 1	4 hrs.	1 year.	6/60	Vitreous opacity.
962	Sweet.	R.	C.	3 x 2	3 days.	1 year.	Imp. L. P.	Cataract.

c = Copper.

DOUBLE PERFORATION.—In the present series there were 23 cases of double perforation of the eyeball by pieces of steel and 10 in which shot passed through the globe and lodged in the orbit. In 10 of the cases enucleation was required, 6 injured by steel and 4 by shot. In the previous report there were 25 cases of foreign bodies shown by the Roentgen rays to be lodged in the orbit, 14 injured by iron and steel and 11 by shot. In 8 cases the eyeball was removed.

EYEBALLS LOST.—Of the total of 185 eyes of the present series in which a foreign body was situated in the eyeball or orbit, enucleation was required in 65, or 34 per cent. In the previous report, 58 eyes were lost of a total of 157 cases of a foreign body localized, or 37 per cent. The causes which compelled the removal of the eyeballs are tabulated below, compared with the cases in the previous reports:

	First Series.	Second Series.	Third Series.	Fourth Series.
Extraction not attempted or failed	14	23	19	12
Iridocyclitis.....	5	14	15	30
Panophthalmitis.....	1	8	14	14
Shrunken or lacerated eyeball.....	2	5	7	7
Sympathetic irritation.....	0	0	2	2
Recurring hem. anterior chamber	2	1	1	0
Total.....	24	51	58	65

In the present series a somewhat different classification has been made from previous reports, so as to exhibit the causes which contributed to the loss of the eyes.

Magnetic foreign bodies:	
Extraction not attempted or failed or panophthalmitis present	32
Extraction successful, but enucleation subsequently required	20
Non-magnetic bodies	13
	65

Of the 32 cases in which enucleation was immediately performed, extraction was not attempted in 2 cases, failed in 10 cases, and in 5 cases the steel was in the orbit. In the

majority of instances the foreign body was of large size, and the eye was practically destroyed at the time of injury. In 24 cases the wound of entrance was through the cornea, in 6 at the limbus, and in 2 in the sclera.

Of the 20 cases in which the steel was removed but the eyes subsequently lost, the enucleation in 9 was within a month after magnet extraction, 6 within two months, 1 in three months, 3 in six months, and 1 within a year. In over three-fourths of the cases the steel was of large size, and enucleation might well have been performed at the time of first examination, as experience has shown that in this class of injury iridocyclitis or shrinkage of the globe ultimately ensues. The destructive effect of these large masses of metal upon the integrity of the eye, to which attention has been called in the previous series, is well shown by the full tabular statements. In 13 cases the entrance wound was in the cornea, in 4 at the limbus, and in 3 in the sclera.

TABLE III.—EYES LOST—EXTRACTION SUCCESSFUL—ENUCLEATION LATER.

Case.	Surgeon.	Eye.	Situation of Wound.	Situation of Body.	Size of Body.	Time Between Injury and Extraction.	Time Between Extraction and Enucleation.	Cause of Enucleation.	Remarks.
719	Radcliffe.	L.	L.	E.	3 x 2	4 days.	5 wks.	Iridocyclitis.	..
734	Van Pelt.	R.	C.	E.	11 x 3	6 days.	1 mo.	Iridocyclitis.	..
738	Pontius.	R.	L.	E.	4 x 2	5 days.	1 mo.	Sympathetic irritation.	..
779	Oliver.	L.	C.	E.	4 x 2	5 days.	1 mo.	Iridocyclitis.	..
791	Pontius.	L.	S.	P.	15 x 2	2 days.	1 mo.	Iridocyclitis.	..
793	Sweet.	R.	C.	E.	4 x 2	1 day.	3 mos.	Iridocyclitis.	..
806	Oliver.	L.	S.	Orbit.	12 x 3	3 days.	6 mos.	Iridocyclitis.	..
808	Ziegler.	L.	S.	P.	15 x 7	5 days.	6 mos.	Iridocyclitis.	Eyeball shrunken.
824	Pontius.	L.	C.	P.	10 x 7	6 days.	2 mos.	Iridocyclitis.	..
855	Zentmayer.	R.	C.	P.	3 x 2	2 days.	10 days.	Iridocyclitis.	Purulent retino-choroiditis.
875	Sweet.	R.	C.	P.	7 x 1	5 days.	2 mos.	Iridocyclitis.	..
886	Ziegler.	R.	C.	E.	3 x 2	3 days.	6 wks.	Iridocyclitis.	Eyeball shrunken.
896	Radcliffe.	R.	C.	E.	3 x 2	5 days.	2 wks.	Iridocyclitis.	Eyeball shrunken.
899	Risley.	R.	C.	P.	1 x 1	6 days.	3 wks.	Iridocyclitis.	..
915	Sweet.	L.	C.	P.	7 x 2	1 day.	5 wks.	Iridocyclitis.	..
921	Sweet.	L.	C.	P.	4 x 1	6 days.	1 year.	Iridocyclitis.	..
935	Fisher.	L.	C.	E.	3 x 1	15 days.	2 wks.	Iridocyclitis.	..
954	Berens.	R.	L.	P.	5 x 2	2 days.	6 mos.	Iridocyclitis.	..
963	Posey.	L.	L.	E.	7 x 5	2 days.	1 wk.	Iridocyclitis.	..
964	Schwenk.	L.	C.	E.	8 x 4	3 days.	2 mos.	Iridocyclitis.	..

TABLE III.—EYES LOST—EXTRACTION FAILED OR NOT ATTEMPTED OR BEGINNING PANOPHTHALMITIS.—(*Continued.*)

CASE.	SURGEON.	EYE.	SITUATION OF WOUND.	SITUATION OF BODY.	SIZE OF BODY.	TIME BETWEEN INJURY AND EXAMINATION.	CAUSE OF ENUCLEATION.	REMARKS.
715	Ziegler.	R.	S.	P.	1 x 1	1 wk.	Iridocyclitis.	Extraction failed.
717	Ziegler.	L.	S.	P.	20 x 4	1 day.	Lacerated ball.	..
724	Fisher.	L.	C.	P.	7 x 2	2 mos.	Iridocyclitis.	Extraction failed.
727	Bromley.	R.	L.	E.	3 x 2	5 days.	Panophthalmitis.	..
733	Fisher.	L.	C.	P.	2 x 1	3 days.	Iridocyclitis.	Extraction failed.
741	Pontius.	R.	C.	P.	4 x 2	1 day.	Panophthalmitis.	Extraction not attempted.
753	Oliver.	R.	C.	E.	5 x 3	3 days.	Panophthalmitis.	..
773	Fisher.	L.	C.	E.	12 x 3	1 mo.	Iridocyclitis.	Shrunken.
778	Posey.	L.	L.	P.	3 x 1	2 days.	Iridocyclitis.	Extraction failed.
816	Posey.	R.	L.	E.	9 x 4	2 days.	Panophthalmitis.	..
821	Sweet.	R.	L.	P.	2 x 2	4 days.	Panophthalmitis.	..
823	Sweet.	R.	C.	P.	5 x 3	6 days.	Iridocyclitis.	Extraction failed.
837	Rhode.	R.	L.	Orbit.	5 x 2	7 days.	Iridocyclitis.	..
850	Berens.	L.	C.	C.	3 x 2	2 days.	Iridocyclitis.	Extraction failed.
863	Bromley.	L.	C.	E.	4 x 2	1 day.	Panophthalmitis.	..
864	Risley.	R.	C.	E.	5 x 2	3 days.	Iridocyclitis.	Extraction failed.
872	Fisher.	R.	C.	Orbit.	4 x 3	2 days.	Intense pain.	Body in orbit.
873	Fisher.	R.	C.	Orbit.	23 x 2	3 days.	Panophthalmitis.	Body in orbit.
890	Ziegler.	L.	C.	E.	6 x 2	5 mos.	Iridocyclitis.	Shrunken.
891	Ziegler.	L.	C.	P.	5 x 2	2 mos.	Iridocyclitis.	Extraction failed.
893	Schwenk.	L.	C.	Orbit.	4 x 3	4 days.	Iridocyclitis.	Body in optic nerve.
901	Posey.	R.	C.	E.	10 x 4	4 days.	Panophthalmitis.	..
900	Sweet.	R.	C.	P.	15 x 15	1 wk.	Iridocyclitis.	..
910	Chance.	L.	C.	C.	3 x 1	3 yrs.	Iridocyclitis.	Extraction failed.
922	Berens.	R.	C.	C.	3 x 1	1 year.	Iridocyclitis.	Extraction not attempted.
923	Radcliffe.	L.	C.	P.	7 x 2	4 days.	Panophthalmitis.	..
942	Risley.	R.	C.	P.	6 x 5	3 days.	Panophthalmitis.	..
943	Pontius.	R.	C.	Orbit.	13 x 8	2 days.	Lacerated ball.	..
955	Fisher.	R.	L.	P.	4 x 2	1 mo.	Iridocyclitis.	Extraction failed.
956	Berens.	L.	C.	P.	4 x 2	3 days.	Panophthalmitis.	..
957	Berens.	L.	C.	P.	3 x 1	2 days.	Panophthalmitis.	..
959	Ziegler.	R.	C.	C.	3 x 1	2 days.	Panophthalmitis.	..

TABLE III.—EYES LOST—NON-MAGNETIC BODIES.—(*Continued.*)

CASE.	SURGEON.	EYE.	SITUATION OF WOUND.	CHARACTER OF METAL.	SITUATION OF BODY.	TIME BETWEEN INJURY AND EXAMINATION.	CAUSE OF ENUCLEATION.	
726	Fisher.	L.	C.	C.	E.	13 days.	Iridocyclitis.	..
756	Zentmayer.	R.	C.	C.	P.	4 days.	Panophthalmitis.	..
758	Sweet.	R.	S.	S.	Orbit.	21 days.	Iridocyclitis.	..
789	Sweet.	L.	S.	S.	P.	1 mo.	Iridocyclitis.	..
797	Cramer.	L.	C.	Z.	P.	7 wks.	Iridocyclitis.	..
804	Schwenk.	L.	S.	S.	Orbit.	3 days.	Iridocyclitis.	..
818	Posey.	L.	S.	S.	E.	1 day.	Iridocyclitis.	..
825	Fisher.	R.	S.	S.	Orbit.	2 wks.	Iridocyclitis.	..
838	Cramer.	L.	S.	S.	Orbit.	5 days.	Iridocyclitis.	..
840	Radcliffe.	L.	L.	S.	E.	1 day.	Iridocyclitis.	..
870	Zentmayer.	R.	C.	S.	P.	2 days.	Iridocyclitis.	..
871	Hansell.	R.	C.	C.	P.	3 mos.	Iridocyclitis.	..
953	Ziegler.	R.	C.	C.	P.	5 mos.	Iridocyclitis.	..

NO FOREIGN BODIES SHOWN BY THE *x*-RAYS.—Of the 280 cases embraced in the present series, 95 were shown by the *x*-rays to have no foreign body in the eyeball or orbit. In every instance there was reason to suspect the lodgment of a foreign body in the eyeball from the character of the injury, the occupation of the individual, and the depreciation of vision. In the majority of cases there was a wound or scar upon the cornea and opacity of the lens. A summary of the cases is given in the following statement:

SITUATION OF WOUND OR SCAR.	TOTAL.	CATARACT.	HEM. ANT. CHAMBER.	HEMORRHAGE OR OPACITY OF VITREOUS.
Cornea	50	20	3	..
Limbus	6	1	1	2
Sclera	7	1	..	3
No wound	32	10	..	11
Total	95	32	4	16

Of the above total of 95 cases, 77 were injured by iron and steel, 2 by copper, usually from the premature explosion of dynamite caps, 3 by small shot, 8 by glass or stone, and 5 by coal. Coal is not shown by the *x*-rays, but examination was made to determine the possible entrance at the time of injury of a particle of metal into the eye.

LATE RESULTS OF OPERATION.—An attempt has been made to secure from time to time a record of the condition of the eye in those cases embraced in previous reports in which a foreign body was successfully removed from the vitreous chamber. Unfortunately, it has been possible to trace only a small proportion of the cases. Many of these patients live at a considerable distance from this city, are unskilled laborers employed in large industrial establishments, and not only change their place of employment but also their residence. In Table IV are given the detailed reports of 61 of these cases.

TABLE IV.—CASES PREVIOUSLY REPORTED—RECENTLY EXAMINED.
STEEL SITUATED IN VITREOUS CHAMBER.

Case.	Surgeon.	Situation of Wound.	Situation of Body.	Time Between Injury and Extraction.	First Report.		Last Report.		Remarks.
					Time Since Extraction.	Vision.	Time Since Extraction.	Vision.	
44	Hansell.	C.	E.	2 mos.	4 mos.	6/30	5 yrs.		Recurrent hemor. ant. chamber.
107	Schwenk.	L.	E.	13 days.	5 yrs.	Shrunken.	8 yrs.	Enucleation.	Iridocyclitis.
414	Sweet.	C.	P.	2 days.	1 mo.	L. P.	2 yrs.		Iridocyclitis.
501	Risley.	C.	E.	3 days.	3 mos.	L. P.	2 yrs.		Iridocyclitis.
676	Sweet.	L.	E.	1 day.	9 mos.	L. P.	5 yrs.		Blow on eyeball.
141	Ellegood.	C.	E.	4 days.	1 mo.	Fingers 5′.	11 yrs.	No L. P.	Eyeball shrunken.
126	McClure.	S.	C.	35 days.	2 mos.	5/10	13 yrs.	No L. P.	Eyeball shrunken.
168	Oliver.	L.	E.	6 days.	3 yrs.	6/30	13 yrs.	No L. P.	Eyeball shrunken.
270	Risley.	C.	E.	6 wks.	1 mo.	L. P.	9 yrs.	No L. P.	Eyeball shrunken.
365	Oliver.	C.	C.	6 mos.	6 mos.	L. P.	8 yrs.	No L. P.	Eyeball shrunken.
407	Oliver.	C.	E.	5 mos.	1 mo.	No L. P.	7 yrs.	No L. P.	Eyeball shrunken.
495	McClure.	C.	E.	3 days.	2 yrs.	L. P.	7 yrs.	No L. P.	Eyeball shrunken.
524	Sweet.	L.	P.	2 days.	2 yrs.	No L. P.	6 yrs.	No L. P.	Eyeball shrunken.
532	Radcliffe.	C.	P.	4 days.	1 year.	Shrunken.	6 yrs.	No L. P.	Eyeball shrunken.
557	Sweet.	C.	E.	9 days.	10 days.	6/12	6 yrs.	No L. P.	Eyeball shrunken.
151	Radcliffe.	C.	C.	2 days.	4 yrs.	No L. P.	11 yrs.	No L. P.	Normal size.
309	Sweet.	C.	E.	1 day.	3 mos.	L. P.	6 yrs.	No L. P.	Normal size.
548	Zentmayer.	L.	E.	1 day.	14 mos.	L. P.	6 yrs.	No L. P.	Normal size.
673	Oliver.	C.	P.	3 days.	8 mos.	5/15	5 yrs.	No L. P.	Normal size.
675	Sweet.	C.	P.	2 days.	6 mos.	L. P.	5 yrs.	No L. P.	Normal size.
120	Ellegood.	C.	E.	7 days.	7 wks.	6/60	12 yrs.	Imp. L. P.	Partial retinal detachment.
145	Posey.	S.	E.	1 day.	6 mos.	6/22	11 yrs.	Imp. L. P.	Retinal detachment.
178	Fisher.	C.	P.	3 days.	2 yrs.	L. P.	11 yrs.	Imp. L. P.	Choroid degeneration.
233	Zentmayer.	C.	P.	1 day.	3 yrs.	Imp. L. P.	5 yrs.	Imp. L. P.	Retinal detachment.
304	Ziegler.	C.	E.	7 mos.	18 mos.	Imp. L. P.	5 yrs.	Imp. L. P.	Retinal detachment before extraction.
339	Fisher.	C.	E.	12 days.	1 year.	6/30	8 yrs.	Imp. L. P.	Choroid degeneration.
379	Posey.	C.	P.	10 mos.	5 mos.	Good L. P.	8 yrs.	Imp. L. P.	Cataract.
464	Van Pelt.	S.	P.	3 days.	14 mos.	Imp. L. P.	5 yrs.	Imp. L. P.	Retinal detach. at extraction.
466	Posey.	C.	E.	2 yrs.	2½ yrs.	Fair L. P.	3 yrs.	Imp. L. P.	Choroid degeneration.
546	Sweet.	C.	P.	1 day.	6 mos.	Shadows.	6 yrs.	Imp. L. P.	Cataract.
547	Hansell.	C.	E.	4 hours.	20 mos.	10/100	6 yrs.	Imp. L. P.	Choroid degeneration.
669	Sweet.	L.	E.	3 days.	3 mos.	Good L. P.	3 yrs.	Imp. L. P.	Partial retinal detachment.
119	Risley.	C.	C.	2 days.	4 yrs.	Good L. P.	11 yrs.	Good L. P.	Cataract.
193	Harlan.	C.	P.	3 days.	1 wk.	Good L. P.	10 yrs.	Good L. P.	Cataract.
450	Dewey.	C.	P.	4 days.	2 yrs.	Good L. P.	7 yrs.	Good L. P.	Cataract.
633	Sweet.	L.	C.	5 days.	10 mos.	Fingers 2′.	5 yrs.	Good L. P.	Cataract.
692	Risley.	C.	P.	2 wks.	1 mo.	Good L. P.	5 yrs.	Good L. P.	Cataract.
648	Sweet.	C.	E.	2 days.	4 mos.	Hand move.	4 yrs.	Hand move.	Capsular cataract.
248	Oliver.	C.	C.	5 days.	2 yrs.	Fingers 9′.	9 yrs.	Fingers 1′.	Cataract.
554	Oliver.	C.	P.	1 day.	6 mos.	Fingers 1′.	6 yrs.	Fingers 1′.	Cataract.
445	Ziegler.	C.	E.	5 days.	2 mos.	L. P.	3 yrs.	Fingers 2′.	Cataract.
623	Zentmayer.	S.	P.	7 days.	2 mos.	Fingers 2′.	5 yrs.	Fingers 2′.	Cataract.
361	Sweet.	C.	E.	4 days.	1 year.	Good L. P.	6 yrs.	3/200	Capsular cataract.
463	Sweet.	C.	P.	20 days.	2 yrs.	6/60	6 yrs.	3/200	Cataract.
139	Sweet.	C.	E.	7 days.	2 yrs.	Fingers 5′.	11 yrs.	5/200	Cataract.
59	deSchweinitz	L.	P.	4 days.	2 mos.	6/5	4 yrs.	6/60	V. = 6/5 for 1 year, then capsule thickened.

TABLE IV.—CASES PREVIOUSLY REPORTED—RECENTLY EXAMINED. STEEL SITUATED IN VITREOUS CHAMBER.—(*Continued.*)

CASE.	SURGEON.	SITUATION OF WOUND.	SITUATION OF BODY.	TIME BETWEEN INJURY AND EXTRACTION.	FIRST REPORT.		LAST REPORT.		REMARKS.
					TIME SINCE EXTRACTION.	VISION.	TIME SINCE EXTRACTION.	VISION.	
261	Ziegler.	L.	C.	3 days.	2 yrs.	Fingers 3'.	9 yrs.	6/60	Capsular cataract.
385	Sweet.	S.	E.	21 days.	2 yrs.	Imp. L. P.	8 yrs.	6/60	Choroid degeneration.
394	Fisher.	C.	E.	2 days.	3 mos.	Good L. P.	7 yrs.	6/30	Choroid degeneration.
476	Harbridge.	C.	P.	2 mos.	2½ yrs.	Fingers 3'.	7 yrs.	6/30	Cataract.
554	Oliver.	C.	P.	1 day.	6 mos.	Fingers 1'.	6 yrs.	6/15	Cataract.
125	Oliver.	S.	C.	1 mo.	2 mos.	6/12	13 yrs.	6/12	..
198	Parker.	L.	P.	3 days.	3 yrs.	5/9	10 yrs.	6/9	Partial cataract.
393	Van Pelt.	C.	P.	2 mos.	3 mos.	Good L. P.	4 yrs.	6/9	Cataract needled.
398	Oliver.	S.	C.	8 days.	1 mo.	6/9	7 yrs.	6/9	..
435	Sweet.	C.	E.	2 mos.	2 yrs.	6/9	7 yrs.	6/9	Capsule needled.
163	Sweet.	S.	E.	9 mos.	3 yrs.	6/6	8 yrs.	6/6	Steel floated in vitreous.
122	Thomson.	L.	P.	2 days.	4 yrs.	6/6	6 yrs.	6/6	..
183	Harlan.	L.	E.	4 days.	3 yrs.	6/6 part.	13 yrs.	6/6 part.	..
285	Sweet.	S.	C.	3 hours.	2 yrs.	6/6	9 yrs.	6/6	..

TABLE IV.—CASES PREVIOUSLY REPORTED—BODY NOT REMOVED.—(*Concluded.*)

				*	†				
334	Pontius.	S.	E.	8 yrs.	1 year.	No L. P.	7 yrs.	No L. P.	Opticociliary neurotomy.
434	Zentmayer.	C.	E.	3 days.	4 mos.	L. P.	7 yrs.	No L. P.	Choroid degeneration.
549	Sweet.	C.	E.	3 days.	3 mos.	L. P.	6 yrs.	No L. P.	Membrane in vitreous.
637	Oliver.	C.	E.	4 days.	5 yrs.	No L. P.	6 yrs.	No L. P.	Shrunken.
672	Chance.	C.	P.	1½ yrs.	1½ yrs.	6/12	4 yrs.	Imp. L. P.	Retinal detachment.
673	Oliver.	C.	P.	3 days.	8 mos.	5/15	5 yrs.	No L. P.	Retinal detachment.

* Time between injury and first examination.
† Period since first examination.

Many of these cases have been personally seen by me, while a certain proportion has been examined by physicians in other cities in which the men live, and I am under obligation to these gentlemen for their courtesy in furnishing an accurate report of the condition of the injured eye. The period between extraction of the steel and the last examination is from five to thirteen years in the majority of the cases, a sufficient time to judge of the results secured in the extraction of foreign bodies from the vitreous chamber. It is possible that some of the other cases in the

previously reported series of successful extractions may have lost the injured eye from subsequent inflammation, but the number of cases which I have examined and recorded in the tabular statement gives a fair idea of the results of operation after a lapse of years.

A summary of these cases, with the visual results secured, is given in the following statement:

VISION.	FIRST REPORT.	RECENT EXAMINATION.
$\frac{6}{6}$	5	4
$\frac{6}{9}$	3	4
$\frac{6}{12}$	3	1
$\frac{6}{15}$ to $\frac{6}{30}$	5	3
$\frac{6}{60}$ or less	3	6
Fingers or hand movement	10	5
Good light perception	22	5
Imperfect light perception	5	12
No light perception, eye normal size	3	6
" " " " shrunken	2	10
Enucleation	..	5

Of these 61 cases, the eyeball was subsequently lost in 5—one five years after extraction for recurrent hemorrhages in the anterior chamber, one eight years and two two years from iridocyclitis, and one five years from iridocyclitis following a blow upon the eye.

In 6 other cases in which extraction of the steel was unsuccessful the eyes have remained quiet. In one the eyeball is shrunken, but in the other five the globe is of normal size. In one opticociliary neurotomy was performed seven years ago, and the eyeball is of normal size and causes no trouble.

In the 18 cases in which vision better than counting fingers was obtained, the wound of entrance of the foreign body was situated in the cornea in 10, at the limbus in 5, and through the sclera in 5. The position of the steel was shown by the Roentgen rays to be in the posterior part of the vitreous chamber in 7, near the equator in 7, and in the ciliary region in 4.

Except in a few isolated instances in both the present and previous series of cases the steel was removed from the vitreous chamber through the original wound, if open, or if closed through an incision in the sclera close to the indicated situation of the body. It is believed that this method produces less traumatism to the structures of the eyeball than extraction through the route of the anterior chamber. As has been emphasized in previous reports, it is difficult to make a satisfactory comparison of the value of operation by the two methods, since the ultimate result depends on a number of factors which are of as great if not greater importance than the method of extraction. Detachment of the retina occurs in a certain proportion of cases in which the steel has penetrated into the vitreous chamber and lodged in the retina or choroid, but this complication is largely influenced by the size and situation of the foreign body and the length of time it has remained in the eye. In instances in which the steel after entering the vitreous drops to the bottom of the chamber, retinal detachment is a rare complication of extraction. It is probable that a certain proportion of instances of retinal detachment are due to the inflammation and subsequent contraction of the new-formed tissue at the point in the retina where the parts have been injured by a fairly large-sized body, or where a smaller body has remained for some days or weeks and considerable traumatism has followed the drag of the magnet in disengaging the body from the exudate in which it is embedded.

In the cases in which a clear media permits an examination of the retina at the site of the incision in the sclera made for the purpose of magnet extraction, detachment of the retina has not been found.

A CONTRIBUTION TO THE HISTORY OF THE MAGNET AS APPLIED TO OPHTHALMIC SURGERY.

H. G. SHERMAN, M.D.,
Cleveland, Ohio.

No class of cases presenting themselves to the oculist cause greater anxiety than those giving a history of an impaction of a foreign body in the tissues, or a penetration and a lodgment of the same within the chambers of the eye.

It nearly always happens that the point of lodgment of a foreign body is difficult to make out owing to hemorrhage or swelling. Should a foreign body be lodged in the tissues of the eye or its chambers it is of the gravest concern, for we know with almost absolute certainty that sooner or later an iridocyclitis or an iridochoroiditis will supervene, with probable loss of the eye in case the foreign body cannot be safely extracted.

We are greatly concerned in regard to the integrity of vision of the other eye in case of violent inflammatory reactions occurring in the injured eye, therefore any means which will aid in the certain diagnosis of the presence of a foreign body within the eye and aid in its removal is heralded with satisfaction. I beg to cite the following case:

Miss Kate W., Warren, Ohio, aged eighteen years, was seen in consultation with Dr. T. M. Sabin June 22, 1894. Inquiry revealed that while working at a machine polishing bamboo filaments for incandescent lamps, a portion of the machine suddenly broke. Patient stated that she thought a foreign body struck her in the eye, as immediately following the accident she experienced acute pain in the eye and a

trifling hemorrhage was observed by her mates. Dr. Sabin gave her a boric-acid solution and assured her that nothing serious had happened. Next day, however, there were a marked circumcorneal injection and considerable pain. This continued in various degrees for a period of two weeks, the doctor in the meantime giving her such remedies as would allay the pain temporarily.

Two weeks after the injury I saw her. A careful inspection of the eye exhibited no condition that suggested the entrance of a foreign body, and an ophthalmoscopic examination showed no disturbance within the eye chambers.

After a few days' observation, the redness and pain subsiding, the girl was sent home; a week later she returned with the aforesaid symptoms greatly aggravated. In doubt as to the causative factor, I requested Mr. J. W. Packard, of the Packard Lamp Company, to cause a thorough examination of the broken machine to be made. He reported that the point of a pin connecting two upright rods was broken off, and, assuming the possibility of it having penetrated the eye, the only positive means of determining its presence in the absence of ophthalmoscopic evidence was by a magnet.

The only available magnet was a small one devised by Gruening. A thorough application of the magnet, however, failed to disclose any response, and the girl continued to suffer severe pain at times, although no marked inflammatory reaction or impairment of vision obtained. Passing a blunt probe over the eye, under slight cocainization, I found at the point of the original redness a sensitive area, and concluded that a foreign body must be lodged in the ciliary region.

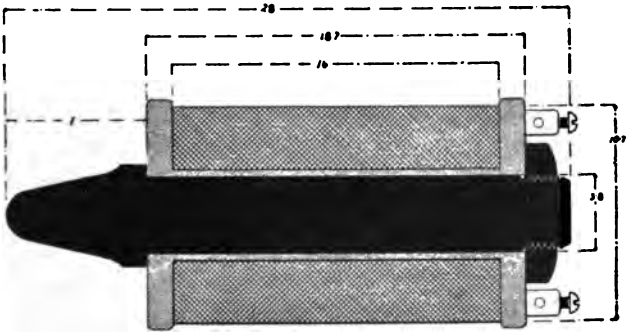
I consulted Mr. Hammer, General Manager of the Brush electric light plant, and requested that he make a magnet for me sufficiently powerful to determine positively the presence of a responsive body in the eye. He directed his chief electrician, Mr. Adams, to construct a magnet after a design made by Mr. Ryder, of the University School, along lines which I indicated. The magnet consisted of a bar of soft Norway iron, 18 inches long and 3 inches in diameter, wrapped with hundreds of feet of fine copper wire, properly insulated. This magnet was energized by the current from the street supplying the arc lamps, and, by means of a trans-

former and a rheostat consisting of 30 coils of iron wire, the voltage was sufficiently reduced to make it safe for the experiment in hand. The traction was greatly increased by an armature of iron connecting the two poles.

The patient's head was brought within six inches of the magnet, the current was turned on, causing her to throw her head backward suddenly, complaining of a sharp stinging pain, assuring the presence of a piece of iron or steel.

I had not thought of removing the foreign body except by incision, the demonstration having been made for the purpose of diagnosis only.

At 6 o'clock on the day of the magnet trial I was called



Cross-section of magnet.

to the hospital and found the girl complaining of a pricking sensation under the lower eyelid. In drawing down the lid I observed a black point projecting through the sclera, partially penetrating the conjunctiva. A slight incision was made over the point and the piece of steel was withdrawn by means of an ordinary dressing forceps. I am happy to state that the girl was sent home at the end of the week with unimpaired vision and no further embarrassment whatsoever.

I may be pardoned for reporting this case in detail, because it has to do with the development of a magnet which exhibited a greater traction force than the Haab (which was unknown to me at the time), probably owing to the larger

wire and greater number of ampere turns about the coil, and also the larger point which conserved the magnetic lines of force, the strength of a magnet being proportional to the ampere turns, provided the iron core is not saturated. On becoming saturated there is no increase of magnetic traction by increase of voltage.

The recent volume of "Graefe and Saemisch's Handbuch" covers the field of magnet development practically completely. It is interesting to note, however, that no mention of this magnet is made either in the article referred to or in any literature pertaining to this subject, notwithstanding the fact that the design of the magnet and the case I am now reporting were published in the *New York Medical Record* in 1895, volume 48, page 212. I feel that it is eminently proper that a record of this magnet should be entered in the proceedings of this Society for its value as historic data.

It is not my purpose in this paper to refer to the various types of magnets and the advantages claimed for each, nor to discuss the comparative results of magnetic extraction by the various methods employed. Magnetism was known to the Greeks centuries ago. Bars of iron magnetized, hand magnets and others dependent upon batteries have been employed for many years.

It would be interesting to take up the various questions of polarity, weight, force, and the magnetic field if time permitted. It is interesting to note, however, that there is no advantage in a large magnet, as the particles of iron or steel penetrating the eye are so small that the ordinary magnet, with adjustable points, now in use is quite sufficient for all purposes. The one I now employ, while of the same general type, weighs less than a quarter of the original magnet, which weighed nearly 60 pounds. The technic applied in the removal of iron and steel in the accompanying cases is as follows:

The patients are placed in a Knapp chair in a half reclin-

ing position, sensibility obtunded by a 10 per cent. solution of cocain, and an aluminum speculum employed to separate the lids. The magnet is then taken under the left arm, supporting the objective point with the right hand, and applying the same to the wound, if open, otherwise an incision is made through the sclera at the point of the original entrance, or at the superior vertical median line. The current is then turned on. In no instance among the many cases that have come under my observation have I failed to remove the foreign body if within the eye. The exit of the chip is greatly facilitated by the use of aluminum retractors and a probe of same in the hands of my assistant.

I fail entirely to comprehend the rationale of any method which permits a foreign body to be withdrawn through or around the lens into the anterior chamber, requiring incision through the cornea for its removal by the Haab or any other magnet of its power. I cannot appreciate the desirability of removing a foreign body through the pupillary space into the anterior chamber with its unwarranted damage to tissues, which may in no sense be implicated, and the attendant impairment or total loss of vision which must necessarily follow.

If the foreign body passed into the eye through this tract, then the same method should be observed as elsewhere. My experience in 183 cases has impressed me with the fact, observed by others, that the resulting damage to the eye is determined by the point of entrance, period elapsing between the injury and the removal of the foreign body, size, character and location; that no technic will insure visual safety—each case is a law unto itself; and whether the foreign body is small or large, smooth or rough in outline, clean or aseptic, we are not warranted in making any prognosis other than unfavorable.

Remarkable as it is, I conceive that no organ in the economy is so tolerant to grave injury as the eye. It

happens, however, to many of us that the most unfavorable prognosis is frequently attended with the most favorable results as regards vision.

The major point that I desire to emphasize is the fact that injured eyes regardless of the severity of the reaction do not require immediate enucleation. Among the many cases which have come under my observation in the past five years I have not had occasion to remove an eye, notwithstanding the fact that the gravest consequences apparently demanded such radical procedure.* After carefully suturing the wound a dressing of vaselin and iodoform is applied, the patient directed to remain quietly in bed with an ice-bag applied, and such analgesics as will allay pain.

While I have occasionally encountered panophthalmitis, calomel is freely exhibited, cold applications continued, and the outcome of the case awaited with confidence.

I am perfectly aware of the avalanche of criticism that this treatment may call forth. This course is such a radical departure from my former methods that I am often amazed by my own audacity.

Previous to the past five years I followed closely the directions laid down by Swanzy; carefully and conscientiously observing my way, however, under the importuning of my patients not to remove their eyes. I am convinced that many eyes have been unnecessarily sacrificed even when there was a degree of vision upon the assumption that sympathetic involvement may supervene. This fear no longer haunts me, as I have not had in the past ten years a case of sympathetic ophthalmitis, although a number of cases of so-called sympathetic irritation have been observed.

I am quite cognizant of the fact, as has been so ably portrayed by Deutschmann, Elschnig, and others, that sympa-

*Substituting evisceration in panophthalmitis, the value of which depends on our acceptance of the theory of transmission in sympathetic ophthalmitis.

thetic ophthalmitis is assuredly a severe disease always attended with dubious prognosis, with no specific remedy to stay its progress; and that here prophylaxis proclaims its triumphs.

In the face of all, there is now and then a note of doubt, and I am giving my patients the benefit of the doubt, trusting that the future will not produce a too severe indictment.

DISCUSSION OF PAPERS OF DRS. SWEET AND SHERMAN.

DR. SAMUEL D. RISLEY, Philadelphia: I wish to call attention to the paper I presented to this Society some years ago, in which it was claimed that the removal of magnetic foreign bodies located in the vitreous chamber should be made through a scleral puncture, the puncture being made as near as possible to the location of the foreign body. This paper was written a few days after Professor Haab had presented his paper before the Section on Ophthalmology of the American Medical Association. I had then recently had a case at the Wills Hospital in which it was possible to locate the reflecting fragment of metal in the lower anterior segment of the ball with the ophthalmoscope. A scleral puncture was made, and the body removed with the Hirschberg magnet. There was no reaction and the resulting vision remained $\frac{6}{6}$. A small gray scar at the site of puncture remained. I have always followed this procedure in all suitable cases. In the paper to which I have again called attention it was claimed that this was the safer procedure, for the reason that the canal in the vitreous caused by dragging the foreign body to the scleral puncture is shorter in most cases than would be the case if drawn forward by a devious route to the anterior chamber, and, therefore, reduces the necessary traumatism to a minimum. If the body is impure, the extent of the infection area is also reduced. The traumatism from the puncture in the sclera is no greater than is probable from the opening of the anterior chamber and the injury to the iris and ciliary region of the eye.

The puncture should be meridional, as this presents less danger from cutting vessels in the choroid and retina. I have many times been able to see the resulting scar with the

ophthalmoscope which gave the impression of the retina and choroid being glued to the sclera, but have never seen a retinal detachment follow the procedure. I do not think it safe surgery to introduce the long tip of a magnet into the vitreous chamber, as it causes serious additional traumatism. Usually, by placing the conical tip of the magnet to the puncture and waiting patiently for a moment or two, the foreign body travels to the magnet and is removed.

DR. E. E. HOLT, Portland, Maine: The papers of Drs. Sweet and Sherman are of intense interest to all ophthalmologists, and I wish to express my appreciation of them and contribute a little to the discussion. I think I was the first to present a series of cases of the removal of metal from the vitreous to this Society, twenty-two years ago, and a second series two or three years later. In these series of cases I used Dr. Bradford's magnet, which was a modification of Hirschberg's. It has been my practice to remove the metal through the opening made by it in entering the eyeball whenever that could be done without too much traumatism to structures of vital importance to sight. Sometimes the wound made by the metal may be enlarged, and it can then be removed with but little additional traumatism. I have found the small strabismus hook of Stevens' pattern serviceable in holding the wound apart to allow the metal to pass out. I have also found a strabismus hook of the regular size, though one in which the hook part is short, a very serviceable instrument to introduce into the wound and then apply the magnet to the hook. By moving the hook about on the axis of the handle you obtain a larger sweep, and engage the hook with the metal, and are able to remove it more readily. If the wound in the anterior part of the eye is small, and much traumatism would be incurred by enlargement, it has been my practice to make a horizontal linear opening into the vitreous in the inferior temporal quadrant of the eyeball. By estimating the direction from which the metal would come from the position of the blow given propelling it to the eye, and the size and position of the wound in the eye, I have been able to remove the metal just as well when it could not be seen with the ophthalmoscope as when it could be seen. I have assumed that wherever

there was a penetrating wound of the eyeball the metal was in the eye or had passed through, as occurred in a very few cases. We should welcome information from every possible source to make our knowledge complete of the size and position of the metal in the interior of the eye. I have not used the *x*-ray because my facilities for doing so were not complete, and because I regarded it of the utmost importance to get the metal out of the eye at the earliest time possible after the accident, for I feel sure that time is a very important element in the successful outcome of these cases. Only last week I had a case that went to a hospital and remained there all day without there being anything done. In the evening I removed quite a large piece of steel with a hand electromagnet. Inflammation set in, accompanied with severe pain and softening of the eyeball, and I removed the eye. This practice, in my experience with such cases, is the best thing to do. I believe, however, that had this case been operated upon in the morning at the time of the accident, the eye might have been saved with useful vision, as it was not necessary to enlarge the wound at the margin of the cornea to remove the steel, which was accomplished readily by the introduction of the strabismus hook into this wound. I remember that at the time I reported my cases I was assured that there would be detachment of the retina beginning at the scar made through the sclera and retina and most of the eyes would eventually have to be removed. I followed my early cases for years, and it has not been my experience to have the retina become detached or to have to remove the eye. I have not made complete statistics of my cases, but am of the impression that when they are tabulated the results would not differ materially from those reported by Dr. Sweet. I have had but little experience with the use of the large magnet, but can fully appreciate the criticisms made by Dr. Sherman in its use, and agree with them in the main. I am inclined to think there are but a few Americans using the large magnet, and that as time goes on the number will steadily decrease. But the number of cases of steel or iron in the interior of the eye removed by the electromagnet now compared with twenty-five years ago is enormous, for then the dictum promulgated was to remove the eye when wounded by such foreign bodies in the "dangerous zone,"

and the unfortunates went to their "family physician" and he removed the eye or got some surgeon to do it. It is a great satisfaction to all of us who have helped to change this universal practice of the removal of the eye to one of conserving it with useful economic vision in the majority of cases.

DR. EMIL GRUENING, New York: As my magnet has been mentioned by Dr. Sherman, I desire to make a few remarks concerning the history of the introduction of magnets in ophthalmic practice. In ophthalmic surgery, previous to 1880, Keogh's magnet, an iron bar pointed at both ends, was the only one in use. I attempted to improve this by strengthening its polarity, joining several steel bars to make a magnetic magazine, in accordance with Coulomb's method. This was a justifiable attempt to improve the permanent magnet then in use. It did not, however, come at a psychologic moment, and was superseded almost immediately by Hirschberg's electromagnet, which appeared simultaneously and had greater tractile force.

I published my paper in the *New York Medical Record*, and, if my magnet has not been cast into the limbo of oblivion historically, it is due to the fact that Hirschberg alludes to it as an anachronism. It would be now, but was not so in 1880.

DR. EDWARD JACKSON, Denver: One of the most important things we can do in this discussion is to emphasize the fact that, what is regarded as orthodox treatment for a certain class of injuries over a large part of the world, is not so regarded in America. That the plan of blindly setting a powerful magnet to draw out of the eyeball a foreign body of unknown size and position is not worthy of the present stage of development of ophthalmology. I want to emphasize what has been said by Drs. Sherman and Risley, and which is implied by the work to which Dr. Sweet has given so much of his effort. It is still current teaching that a routine method of using a powerful magnet, irrespective of the nature of the particular injury, is the best method for the extraction of magnetic foreign bodies. At the meeting this winter of the Colorado Ophthalmological Society were shown three cases treated by extraction with the hand magnet,

through a scleral incision, after *x*-ray localization of the foreign body. One was shown after five years, all of them with very good vision. At that same meeting was shown another case of recent injury that was very instructive. An *x*-ray determination of the position of the foreign body was made, and it was found to be about the center of the vitreous. The media were all cloudy, so that it could not be located with the ophthalmoscope. Repeated attempts were made with the giant magnet in the orthodox way. They failed utterly. A few days afterward the patient came into the hands of Dr. Libby, and I was asked to coöperate. We endeavored to extract through the scleral opening and failed. The eye was enucleated. We found the foreign body was no longer in the center of the vitreous, but firmly embedded in the ciliary body. There was an abscess where it had been near the center of the vitreous, and there was a considerably larger abscess where the foreign body was embedded. The giant magnet, used in the routine way, and by a man of good experience, had sealed the fate of that eyeball. If the attempt had been made even with the same instrument to draw that foreign body out through a scleral opening in the ordinary position, probably it would have been successful.

DR. W. B. MARPLE, New York: There is one point to which I wish to refer. Three years ago we had a paper on this same subject, and a considerable discussion, in which I took a small part, followed as to the possibility of removing these bodies through a scleral opening.

The following summer I passed through Zürich, and our dear friend, Professor Haab, called me mildly to task for suggesting any other route than through the anterior chamber, for we all know that he favors removing practically all foreign bodies in this way. We have been told that there is greater danger of detachment of the retina where the foreign body is removed through a scleral opening, and I am wondering whether Dr. Sweet or Dr. Sherman can throw any light on this point. So far as my own observation goes, it seems to me that there should be no hard-and-fast rule, but that every case should be treated on its own merits. If a foreign body has gone through a scleral wound, I usually extract through the wound of entrance. If it has entered

through the anterior segment, I extract by way of the anterior chamber, invariably if the lens is injured. I am sure I extract a great many more foreign bodies *via* the anterior chamber than through the sclera.

DR. JOHN E. WEEKS, New York: The tendency this morning is to advocate the removal of foreign bodies through the sclera. Professor Haab, as we all know, takes the opposite view. I really think that there is a great deal of merit on both sides. I do not think we ought to make any fast rule in regard to the tract through which we should remove a foreign body; every case should be decided on its merits. In many cases we will do less injury by removing the foreign body through the anterior chamber than through the sclera, choroid, and retina. In not a few cases the removal of a foreign body by the route through the anterior chamber is attended by almost no traumatism.

DR. W. E. LAMBERT, New York: I would emphasize what Dr. Weeks has said, that we cannot lay down any hard-and-fast rule. The size and form of the foreign body, its situation, and the length of time that it has been in the eye are important factors in determining the method. We find that in many cases where the foreign body is small, the extraction through the anterior portion of the eye is the best method, while, on the other hand, a ragged piece is undoubtedly best removed through the sclera. In other words, localization by the *x*-ray is the important guide in these cases.

DR. S. LEWIS ZIEGLER, Philadelphia: As long as we are mentioning matters of history, I may refer to a little incident, which occurred about twenty years ago, that was probably the first time that the magnet and storage battery were combined together, a fact which interested Dr. Sweet very much, and may or may not have helped to develop his magnet, so it was probably of some value. In 1892 I purchased a Hirschberg magnet in Berlin, which did not prove to be strong enough for the purpose I wished. I therefore had it rewound with heavier wire for use with the storage battery. Prior to that time, at least in Philadelphia, no such combination had been made, as the weaker acid battery had always been used. One of the first cases that I

used it on I presented at the College of Physicians. This patient had a perforating wound through the periphery of the lens and iris, the foreign body having lodged in the retina about 1 disc diameter from the optic nerve. I saw the patient immediately after the injury, and was able to diagnose the foreign body with the ophthalmoscope, and operated about three hours later. I made a meridional incision through the sclera, presented the magnet tip to the wound, and removed the foreign body. The eye recovered without any complication. I recall that, when the patient was shown at the meeting of the Section on Ophthalmology about three months later, Dr. Norris felt skeptical as to the prognosis of the eye. He believed that most foreign-body cases developed trouble at some future period and came to enucleation. I have seen the patient during the past year and retested him for glasses. His vision has remained normal. The other eye had a traumatic cataract dating from infancy which I have since operated on. The man is an artistic decorator, has had to use his eye very closely, and all these years has had efficient vision in the injured eye.

In regard to the removal of the foreign body according to Haab's method, which I have done but few times, I once met with an unfortunate experience which prejudiced me against the method. The case seemed so favorable for this technic that I yielded to the temptation to try it. The patient had a perforating wound through the ciliary region, not very far from the sclerocorneal junction, and I felt that such a case, if any, would warrant the use of the Haab magnet to draw the foreign body through the wound of entrance. Now it so happened that this foreign body had jagged edges, and in coming out it was just near enough to catch in the ciliary body and to entangle the iris and draw the iris out. In other words, I had a complicated wound and a spoiled pupil to contend with. While the complication was more or less a cosmetic one, it only proved to me that this was not the best method of removing a foreign body. I am of the opinion that the scleral route is the best route in the majority of cases, and I almost invariably resort to it. I have never seen detachment of the retina occur at the point of scleral incision. In fact, the fresh wound should encourage adhesion

of the retina, in the same way that this occurs after posterior sclerotomy for retinal detachment.

DR. S. C. MAXSON, Utica, N. Y.: If the foreign body has been drawn from the vitreous into the anterior chamber and becomes caught in the iris, extreme care must be exercised after the corneal incision is made not to again apply the magnet, otherwise there is danger of pulling out and tearing the iris as the foreign body is extracted. This matter was forcibly brought to my attention by the remark of one of our members a number of years ago in the discussion of foreign-body injuries. Soon after this I had a case in which the foreign body became entangled in the iris, and, after making an incision with the keratome, I drew out the piece of steel with the iris forceps, performed iridectomy, and had a perfect result. I believe there is considerable danger in the use of the giant magnet. I have a Sweet magnet, but, instead of holding it under the arm, I suspend it by a pulley with a counter-weight, and am able to adjust it to my liking.

DR. PETER A. CALLAN, New York: I am very loath to enter into the discussion on this subject where the personal equation plays an important rôle. The reason I make the remarks is that the scleral opening has never shown, according to several gentlemen here, resulting detachment of the retina. I must have been very unfortunate. I have had several detachments of the retina following the old method. Every case must be handled individually according to the circumstances—point of entrance, size, location, and length of time—everything—must be taken into consideration. I think I have had my fair share, perhaps more than my share, and have been fairly successful, but ever since Haab has shown the method bringing it around into the anterior chamber I have followed that method, and, except in a very few instances, I have been successful. I do not say this boastfully, but my records show. A good deal of manœuvering and shifting the poles of your Haab magnet are necessary in order to get the foreign body into the anterior chamber. When in the anterior chamber, stop the use of the big magnet, and with the small magnet bring the foreign body around on the iris, above, directly under the point you want to make your corneal incision. Make your corneal incision,

apply to that opening the small magnet, and the foreign body jumps out without bringing the iris into the wound. I do not mean to say we should not employ the scleral route. Let each man decide for himself. I do not think any method should always be adhered to if a man feels that he is going to do damage or injury, but by long odds in my estimation Haab's method is the best.

DR. WILLIAM M. SWEET, Philadelphia: I do not think it necessary to consider at this time the relative merits of extraction by the route of the anterior chamber or through a scleral incision. The more foreign body cases I see the more I am convinced, as I said in a discussion of this subject three years ago before this Society, that each case must be studied as a separate and distinct condition, and that the ultimate results secured by operation depend not so much on the method of extraction but more on the nature of the injury, the length of time the foreign body has been in the eye, and the ease with which it is removed. In the earlier days, before the value of the Roentgen rays was recognized, the plan of drawing all foreign bodies into the anterior chamber, without definite knowledge of their size or position, was not a scientific procedure. At the present time, with the more accurate knowledge we have, I believe that, if this method of extraction is employed, it should be restricted to recent injuries in which the Roentgen rays show that the body is of small size and not deeply embedded in the structure of the ball. A foreign body that has been in the eyeball for a sufficient period to be held in position by inflammatory exudate will not come forward under the diminished power of the magnet required in recent injuries. The magnet must, therefore, be brought close to the cornea with the current at full strength, and the steel, as it is loosened from the tissue in which it is embedded, comes forward with a pull greatly in excess of what is safe for the body now free in the vitreous, with the frequent result of a tearing of the anterior structures of the eye, or possibly the embedding of the steel in the ciliary body.

As regards detachment of the retina, this is an unfortunate complication that may follow in any case of the lodgment of a foreign body in the vitreous. As I have previously stated,

I believe that it is due more to the inflammation and subsequent shrinkage of the new-formed fibrous tissue that must follow embedded foreign bodies than to the method employed in extraction. I have not found, however, retinal detachment at the situation of the scleral incision.

DR. H. G. SHERMAN, Cleveland: I trust that some one will be able to elucidate the few points which are obscure to me. Before I modified the large magnet I made a series of experiments, placing particles of iron of various shape, size, and weight, within the chambers of pigs' eyes, which we securely fastened in the operating mask. When within the range of magnetic influence the iron flew instantly in the most direct line toward the point of saturation in the magnet, arrested only by the tissues blocking the path. Invariably the obstructing tissues were lacerated, punctured, or displaced by the force of the traction, and yet I read of cases in the hands of others employing the so-called Haab's method of withdrawing foreign bodies through pupillary steps with happy results. I fear my technic must be faulty, indeed, as I hesitate to pursue such methods on the living subject.

EXHIBITION OF NEW INSTRUMENTS AND APPARATUS.

NEW CATARACT GLASSES.

J. HERBERT CLAIBORNE, M.D.,
New York.

Some time ago a patient of mine had a new form of cataract glass made by Bausch, an optician of Rochester, which was lighter and better looking in every way than the one he was wearing.

It consisted of a small toric convex lens in which there was an invisible lower segment; on the concave side of the

toric lens, covering both the distance part and lower segment for reading, was a thin, circular paster, and the adjustment of the several values was so arranged that the distance correction consisted of the toric plus the paster; and the correction for near consisted of the bifocal segment plus the paster.

In another patient, for whom I had prescribed a sph. +12 for distance and +14 for near, and whose vision was $\frac{30}{30}$, and who could read fine print with ease, I made a modification of the Bausch glass. This was ground by Elting and Pickup, of New York, and consisted of a thin, curved, non-refracting glass, with a fused plus segment below, and over this was placed the paster on the curved side (Fig. 1). I found, however, that with the strength of glass just mentioned she could not see quite as well as with her heavy pebbles. We then gave her the distance correction of +13 and the near correction of +15, which simply involved an increase of the paster strength of one diopter. With this glass she saw $\frac{20}{20}$ with each eye, stated that she used both eyes together much more satisfactorily, that the definition of all objects was better, even than with her pebbles, and that she judged distance better.

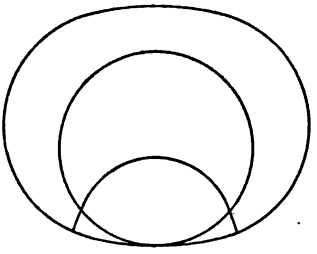
The difference between these two glasses is obvious: The old distance glass weighs $1\frac{1}{2}$ ounces; the reading, 2 ounces; while the new glass (bifocal) weighs $\frac{3}{4}$ ounce. Moreover, the appearance of the patient is greatly improved. She is rendered less conspicuous, and the set of the glass, by reason of its lightness, is better and more easily adjusted.

In addition to the change just mentioned from the Bausch glass, I diminished the size of the paster and brought it completely down to the lower edge of the foundation glass. I think it possible to decrease the size of this paster further and render the patient still less conspicuous, while its usefulness will be preserved. This, however, is to be determined by experiment. I suggest, also, in case patients do not

desire bifocal combination, that the paster alone be placed over a plain toric lens for distance, and that for reading a stronger paster be used in a similar way.

It is advisable also that neither the foundation glass nor the paster should be too large, and, in fact, it is not necessary, otherwise there will be but little difference between the unsightly old ones and the new. I recommend the following measurements in the construction of this glass: Horizontal diameter, 40 mm.; vertical, 31 mm.; paster, circle of 25 mm. diameter; reading segment vertical, 12 mm.; horizontal, 19 mm.

To construct a lens of this description a toric Kryptok



New cataract glass.

Section of glass.

blank was selected as a base; on the outer side was ground a plus 6 curve; on the inner, a minus 6 curve; the result was a toric Kryptok lens with a plano upper and a plus 2 reading. Particular attention was paid to having this lens ground thin, it being but 1 mm. in thickness. The focus grinding part of the basic lens being completed, it was cut to size and the edge finished. As has been stated, the upper part of the Kryptok lens was plano, the lower +2 D., and the strength required was +12 D. for distance and +14 for reading. It was therefore necessary to add that amount of power, which was obtained by using a knife-edge round segment, similar to those used in Opifex bifocal work, only 25 mm. in diameter. The curve on this segment was plus 6 on both sides;

the two parts, the basic lens and the segment, were now cemented together, care being taken to attach the segment down so low that when used for close-work the full reading strength would be available to the very bottom.

DISCUSSION.

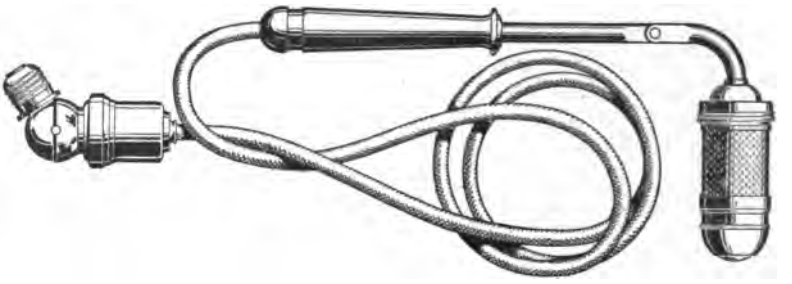
ALBERT C. SNELL, Rochester, N. Y.: I wish to add a little previous history to the form of cataract glasses exhibited by Dr. Claiborne. Dr. Claiborne's patient was shown a pair of glasses which Mr. Sandrel, proprietor of Hotel Seneca, of Rochester, and a patient of mine, was exhibiting with great satisfaction. These glasses were made by Bausch and Lomb, of Rochester, N. Y., in an attempt to reduce the weight of the usual cataract glass. I suggested merely that the weight could be reduced, but the form of construction was worked out by the manufacturers. Dr. Claiborne has modified the glasses as originally constructed by having the bifocal invisible paster mounted at the lower edge of the glass, whereas in mine it was mounted in the center. A number of my patients have been wearing these glasses for more than a year and are greatly pleased with them.

ELECTRIC OPERATING LAMP

Dr. S. Lewis Ziegler, of Philadelphia, exhibited a surgical photophore of the Nernst type, which he had by experiment gradually developed into a practical and efficient operating lamp. It is light in weight, and can be conveniently held in the hand of an assistant. The superior qualities accredited to this lamp are as follows:

1. High illuminating power.
2. Uniform steadiness of light.
3. Preservation of normal color-values, as in sunlight.
4. Accurate focalization of light.
5. Ease of adjustment to surgical requirements.
6. Economy of current consumption.
7. Universal cut-out for both direct and alternating currents.

The fact that this photophore not only reveals the very minute details of the delicate tissues about the eye, but also preserves the normal color-values, as seen in sunlight, makes it especially useful for the ophthalmic surgeon. As a rule, the candle-power of the lamp averages about 50 c. p., but may reach as high as 70 c. p., when the proper condensing lenses are adjusted, as in the ophthalmic focalizer. The burner requires four-tenths of an ampere, and the low consumption of current reduces the average cost of operating the lamp to less than one-half cent per hour. It can be



Electric operating lamp.

used equally well on the direct and on the alternating current, as the cut-out is universal and automatic.

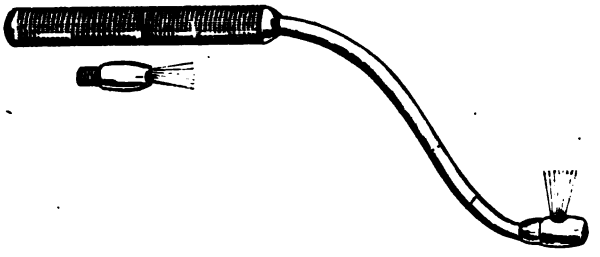
After the current is turned on it usually requires from one-half to one minute before the burner becomes heated and full brilliancy is secured. The photophore is then ready for direct illumination of the operative field. Ordinarily, the lamp should be held about one foot away from the point of operation. For ophthalmic operations, the lamp should be set at right angles to the handle, and the illumination directed obliquely. As the lamp may give off considerable heat, all physical contact with it should be avoided. For the same reason the lamp should not be laid on a painted surface, where it

might soften the paint and stick fast, but should always be hung up by means of the metal goose-neck.

In very delicate operations, like secondary capsular cataract, the ophthalmic focalizer may be attached to the photophore, and the small peripheral lens held from eight to ten inches from the eye. This will yield a much smaller, but more intense, area of light. A transilluminator with asbestos collar and cylindric glass tip may be added to the focalizer whenever it is desired to make an accurate study of intraocular growths. The photophore is manufactured by the Pittsburgh Electric Specialties Co.

POSTERIOR OCULAR TRANSILLUMINATOR.

Dr. Walter B. Lancaster, of Boston, demonstrated a new instrument, the object of which is to make it possible to transilluminate the posterior part of the eyeball from behind.



Posterior ocular transilluminator.

A tungsten lamp is mounted on the end of a copper tube, which contains the necessary insulated wires. The tube is about 3 mm. in diameter and 70 mm. long. Current is supplied by the well-known pocket-flash-light battery.

The tube, being of soft copper, can be bent to suit the requirements of the case. The illustration shows one end bent to fit the curve of the globe while the other is bent in the opposite direction to keep the handle from obstructing the view of the pupil.

In using the instrument it is necessary to make an opening in the conjunctiva and the capsule of Tenon through which the lamp is passed directly to the point desired. As the method necessarily inflicts more or less traumatism, it is recommended only in cases where the alternative is a more serious operation or perhaps the risk of doing nothing until the diagnosis is unmistakable, a delay which may be fatal.

Doubtless others have thought of and perhaps tried some such method as this. It occurred independently to Dr. Verhoeff and myself, and probably has to others.

The instrument was demonstrated on a rabbit, and, although the room was not darkened, the pupil showed bright illumination.

BATTERY ATTACHMENT FOR ELECTRIC OPHTHALMOSCOPE.

Dr. David Harrower exhibited a simple, cheap, and effective illumination for the Morton-Marple electric ophthalmoscope. This consists of the usual metal case, flat in shape, containing the two-cell battery that is screwed into the instrument. On the side of the cylinder is a sliding contact which permits the illumination.

At the point where the lamp screws into the battery cylinder is a threaded support, 2 inches long, which holds the lamp.

The illumination is regulated somewhat by drawing out the tube as one can do with the ordinary Marple ophthalmoscope.

DISCUSSION.

DR. W. B. MARPLE, New York: We ought to be grateful to Dr. Harrower for his ingenious and cheap battery in the handle for the electric ophthalmoscope. I trust that he will pardon me, however, if I express my criticism of it, for I have been trying a long time to solve satisfactorily this problem of the battery in the handle. In the first place, he has discarded the movable lamp, which is one of the most valuable features of this ophthalmoscope; and, in the second, there is no arrangement for controlling the brilliancy of the illumination which a good instrument should possess. Patients dislike to have too brilliant a light thrown into the eye. Finally we ought to be able, by turning the handle, to have a vertical image of the filament in the mirror.

Dr. Marple showed a model possessing all the above valuable features, but admitted that it was too large, a fault which he was endeavoring to have eliminated.

PRESENTATION OF CASES.

I. A SECOND CHAPTER IN THE HISTORY OF A SUBRETINAL MASS (WITH PATIENT).

II. TWO CASES OF SYMPATHETIC OPHTHALMIA (WITH ONE PATIENT).

ROBERT L. RANDOLPH, M.D.,
Baltimore, Md.

SUBRETINAL MASS.

Permit me, in a few words, to refer to the history of this patient, who was exhibited before this Society at its last meeting here three years ago. I saw him early in the autumn of 1909. The vision of his right eye was $\frac{20}{200}$, and in the affected eye the vision was $\frac{20}{00}$. Pupillary reactions normal and media clear. The affected eye contained a

mound-like mass, situated beneath the retina, somewhat below the equator of the eye, near the macular region, and covering about four and one-half times the area of the disc, and with an elevation of a little over four diopters. Those of you who saw the ophthalmoscopic picture will doubtless recall it. Tuberculosis, lues, and leukosarcoma were the things suggested by this mass. As I mentioned at that time, the usual treatment for tuberculosis and lues was faithfully tried, but with no apparent effect. I might say, as will be found in the "Transactions" for 1910, that both the tuberculin and Wassermann tests resulted negatively. At one time he took $\frac{1}{100}$ milligram of tuberculin twice weekly for three months. For seven months he took as much as 100 grains of potassium iodid three times daily.

For two years no objective change was observed, but during the past five months I have noticed that the lower and inner aspect of the mass has been getting irregular and rough, and losing its clearness of contour. While the summit is still quite round, there are slight indentations along the slopes. The base is somewhat shrunken, particularly along the outer and lower sides of the tumor. The evidences, to my mind, of its inflammatory character or origin are strongly suggested by the changes seen just below and to the outer border of the tumor. I am still of the opinion that it is a rare form of choroidoretinal inflammation, and that the mass is a massive exudate which I am of the opinion will probably be absorbed in the course of time.

SYMPATHETIC OPHTHALMIA.

This boy consulted me November 23, 1911. He is now eight years old. Early in October of that year he was injured by the explosion of a railroad torpedo with which he was playing. One piece of the torpedo entered his right leg, another piece his chin, and a third piece his right

eye. The piece in his chin was removed at once, and that in his leg was cut out three months later. I did not see him till seven weeks after the injury. He had never seen anything more than light after the injury. When I first examined him the left eye was somewhat sensitive to light and rather watery, with a very faint, deep-seated pericorneal redness. The vision was apparently unimpaired. I was unable to get a very satisfactory view of the fundus, as the child was tired from a long railroad journey, and I simply instilled a drop of atropin in the eye and advised immediate enucleation of the injured eye, as it was markedly soft.

When I saw the child the next day I found two little adhesions at the inner and upper border of the pupil, while there were several specks on Descemet's membrane—a typical picture of sympathetic ophthalmia. Treatment was kept up continuously until the middle of March, and he was in the hospital all the time. He averaged 40 grains of sodium salicylate in twenty-four hours practically all this time. Once or twice I had to suspend the drug for two or three days, but for never longer, and it was surprising how well his stomach tolerated the medicine. Many times I thought the case was hopeless, and more than once I felt greatly encouraged by the disappearance of the pericorneal redness and by the fully dilated pupil, but the disease would usually break out again with increased pericorneal redness, with sluggish pupil and muddy media. By the middle of March, *i. e.*, after nearly four months of anxious treatment—I let him go home with vision $\frac{20}{200}$, and with adhesions almost the entire length of the pupillary margin. During all this time he always got at least three instillations of atropin a day. After reaching home mercurial inunctions were employed for a time, and for several months he kept up small doses of potassium iodid. When I saw him last autumn, two years after the accident, his

vision was $\frac{20}{100}$. I have not had an opportunity of testing his vision since. One can see that the child looks remarkably well and the eye is bright and useful, but from the condition of the pupillary border and the somewhat shallow anterior chamber one must realize that the outlook is bad. I consider it so.

The other case, which failed to make his appearance, presented a much less discouraging picture, and I believe his chances are excellent. He was injured by a blow from a whip. The sympathetic affection showed itself in six weeks after the reception of the injury. At this time I first saw him. At one time the patient was not able to count fingers 15 feet away. He can now read and has entirely regained his efficiency. He has two small adhesions at the lower border of the pupil. He is a farmer, fifty-five years old.

I have brought these cases before the Society not only on account of the rarity of the disease, but to show the great mistake of temporizing with this class of patients, especially when the individual is a child. It is far better to sacrifice a great many eyes which are useless so far as sight is concerned, than to make the mistake of temporizing and bringing about such a tragedy as both physicians did in the two cases just recorded. Sympathetic ophthalmia is peculiarly tragic on account of its preventableness.

TWO CASES OF BINOCULAR COLOBOMA OF THE OPTIC NERVE IN THE SAME FAMILY.

GEORGE S. CRAMPTON, M.D.,
Philadelphia.

Coloboma of the optic-nerve entrance is one of the rarest of congenital anomalies, especially if unassociated with a defect of the surrounding choroid. The condition is differently described by writers as coloboma of the optic nerve or of the nerve entrance, or as coloboma of the sheath of the nerve. While one or other term has been used to describe the condition as seen with the ophthalmoscope, later histologic studies are quite at variance with the results of the fundus examination. Occasionally a cystic enlargement of the nerve-sheath gives the scleral opening an undermined appearance, and, while the enlarged scleral aperture may be free from apparent notching at its lower margin, as was shown in a case published by Manz[1] in 1891, yet, as in his case, it is impossible to tell with the ophthalmoscope whether or not there is a true coloboma of the nerve or its sheath. Coats[2] agrees with von Hippel[3] that the lesions, even in cases which closely resemble each other clinically, present no uniformity microscopically, and believes with him that the term "coloboma of the nerve" should replace that of "coloboma of the nerve entrance." That this nomenclature may lead to confusion is shown in Cosmettatos'[4] cases, in which the anomalies are entirely confined to colobomata of the choroid surrounding normal discs, and are published under the title of "Coloboma of the Nerve Entrance." Reliance must be placed upon the ophthalmoscope, at least until years later, when an autopsy might throw further light upon the case.

A convenient classification would consist of two groups—one in which no choroidal fault in the margins of the pseudo-disc is shown by the ophthalmoscope, and the other those cases in which microscopic examination indicates the nature of the defect. The latter series should be published with full microscopic details, so as to eliminate the difficulties in understanding the complex and misleading relations due to varying congenital changes.

There seems to be a diversity of opinion as to the rarity of coloboma of the optic nerve unassociated with a similar defect of the adjoining choroid. Vossius[5] found only 3 cases in 12,000 patients, and Casper,[6] in 1885, collected a total of 20 cases, which number was increased to 48 by Saemisch[7] in 1891. Coats,[2] in his excellent monograph published in 1907, gave a total of 6 unequivocal examples, including his own, in all of which he had made histologic examinations.

It seems probable that some writers include cases of incomplete colobomata, which should more properly be classified separately, as they appear to be more nearly allied to the extreme type of the common physiologic cup. It is also likely that some have included cases in which there is a small defect in the adjacent choroid. Collins and Mayou[8] account for the formation of colobomata in this region as follows: "The fetal ocular cleft normally closes early in fetal life, cutting off the mesoblastic structures external to the secondary optic vesicle from those internal to it.

"In some animals a permanent union between the mesoblastic structures inside and outside the eyeball exists, the ocular cleft never becoming entirely closed. In fish the falciform process projects upward through the cleft and in birds the pecten.

"Occasionally in man a union is found to have persisted between the tissues external to the retina and the vitreous humor, which is usually atypically developed, in the region of the cleft. Such a union must necessarily prevent the

edges of the secondary optic vesicle coming together and a gap or coloboma in the retina results. Eyes with this form of coloboma and atypically developed vitreous do not expand to the full extent and are microphthalmic.

"A delay in separation of the external and internal mesoblast, without permanent union, may also result in failure in the closure of the cleft in the secondary optic vesicle and the formation of a coloboma. When this occurs, the changes are not limited to the structures derived from the secondary optic vesicle, but involve also those immediately external to it. If the defective closure is in the extreme posterior part of the cleft, there is a coloboma of the optic nerve-sheath; if somewhat further forward, a coloboma of the choroid; if near the anterior lip of the cup, a coloboma of the ciliary body and of the iris which normally grows forward from it."

According to Parsons,[9] the shape of the coloboma is generally round or vertically oval; the size may be from twice to twenty times the usual diameter of the disc. Total excavation is uncommon, and the greater depth of the lower part is the rule. Collins and Mayou state that conditions which are termed colobomata of the optic nerve are often colobomata of the choroid, reaching up to the nerve, which have become ectatic, so that the lower border of the nerve is displaced upward and backward, the surface of the papilla facing downward. In such cases the sheath of the nerve is not involved in the coloboma. Van Duyse[10] ascribes to colobomata of the optic nerve the following characteristics: (*a*) Enlargement of the papillary area with irregularity of form; (*b*) partial or total excavation, the greatest depth being in the lower part; (*c*) glistening white surface alternating with shades of gray in the excavated portions; (*d*) special disposition of the vessels. Beard[11] states that often the excavated portion is surrounded by what seem to be exaggerations of the pigment and scleral rings, and, when the whole area within the scleral ring is depressed, he likens the

condition to that of a magnified glaucomatous excavation. In a coloboma of the nerve alone, according to Collins and Mayou, the nerve-entrance is practically of normal dimensions, and all the abnormalities are within its boundaries. A fold of retina is then found passing through the lamina cribrosa and hollowing out the nerve. Pathologically, it would be differentiated from one involving both choroid and nerve by the relation which the excavation bore to the intervaginal space in the sheath of the nerve. If on its inner surface, it would be a coloboma of the nerve; if on the outer surface, a coloboma of the choroid.

Caspar's classification of the arrangement of the vessels is widely quoted. He divides them into three groups: (1) Those in which all the vessels emerge from the lower part of the pseudo-disc, even those which subsequently turn upward. (2) Those in which the vessels emerge at or a little above the center, and are nearly normal in arrangement. (2) Cases in which the vessels appear at the edges around the whole circumference of the disc. It seems to be agreed that, in the latter formation, the vessels are generally cilioretinal.

Vision has been found to be normal in some instances and entirely lost in others. If both eyes are affected, as Beard thinks is commonly the case, it is usual to find one with almost normal vision and the other blind, as in the author's cases.

The cases studied by the writer were a brother and sister, the former exhibited before the Society, In both the right eye was blind, while the vision of the other was almost or quite normal. The mother and two younger brothers were free from ocular anomaly, while the father and elder brother, who were not examined, were said to have no eye trouble. The parents gave no history of consanguinity or venereal disease. The maternal grandfather had defective vision, one eye turning upward more than the other.

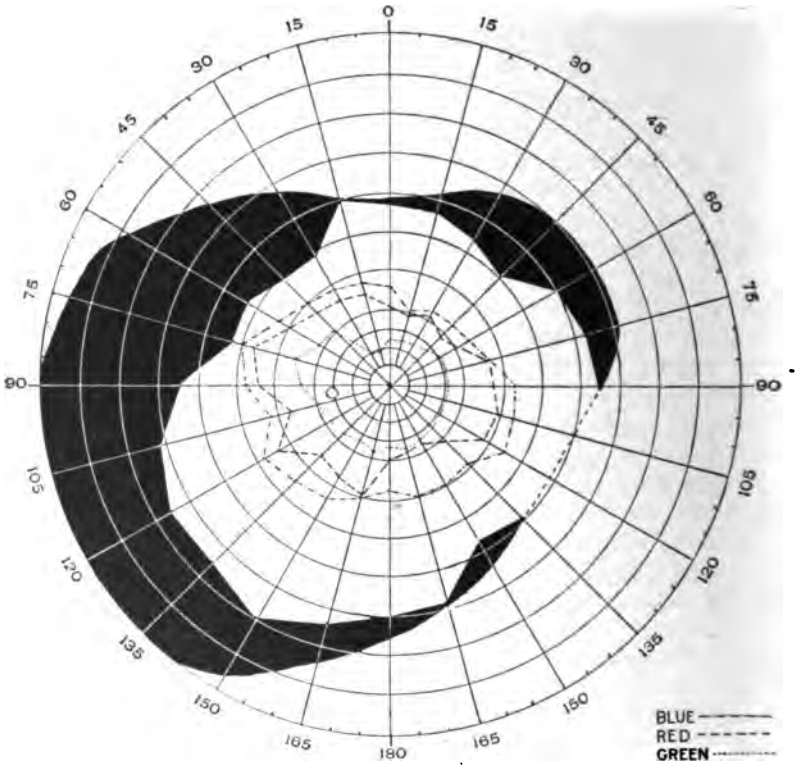
CASE 1.—A rather timid, blond young man, aged twenty, who, although blind in the right eye since birth, had never consulted an oculist and only recently applied for treatment at the Wills Hospital, where he was placed under the care of Dr. P. J. Pontius, through whose courtesy I have the privilege of reporting the case.

The eyes are both of normal size and practically straight. The corneæ and irides are normal, but the right pupil is enlarged and there is only consensual response to light, the other acting normally. There is no nystagmus, but nictitation has been excessive and involuntary. The right eye can wink alone, but on attempting to wink with the left, both lids close. The vision of right eye is reduced to poor central light perception. Of two small lights held before the eye, one alone can be seen, even though they be brought together. V. L. E., uncorrected, $=\frac{6}{9}$; with —0.25s.⊂—0.37c. axis $30° = \frac{6}{6}$, the field being but slightly reduced.

The fundus of the right eye presents a striking appearance, the papilla having been replaced by a large, almost round, sharply defined scleral aperture which appears to be about two and a half times the size of a normal disc, although a myopia of 6 D. no doubt accentuates the size. The depths of this gray, homogeneous looking cavity, when explored with a —18 D. lens, disclose the presence of a shadowy vessel, which, arising centrally, branches and passes downward out of view, but is no doubt the origin of the two groups of inferior vessels which pass from the undercut edge of the pseudo-disc to the retina. Above, two similar groups of vessels appear from beneath the undermined edge and pass upward in a fairly normal manner. The aperture is remarkable for its thin, cleanly cut edges, which are laterally dashed with two narrow spots of pigment. Equally clean cut are three wing-like, grayish-white, choroidal faults which inclose the disc except on its temporal side. The area of exposed sclera on the nasal side is about the size of the scleral aperture, while the areas above and below are half this size and are well shown in the sketch. The remainder of the fundus, although the seat of some slight pigment disturbance, is apparently normal, and there are no evidences of a raphé.

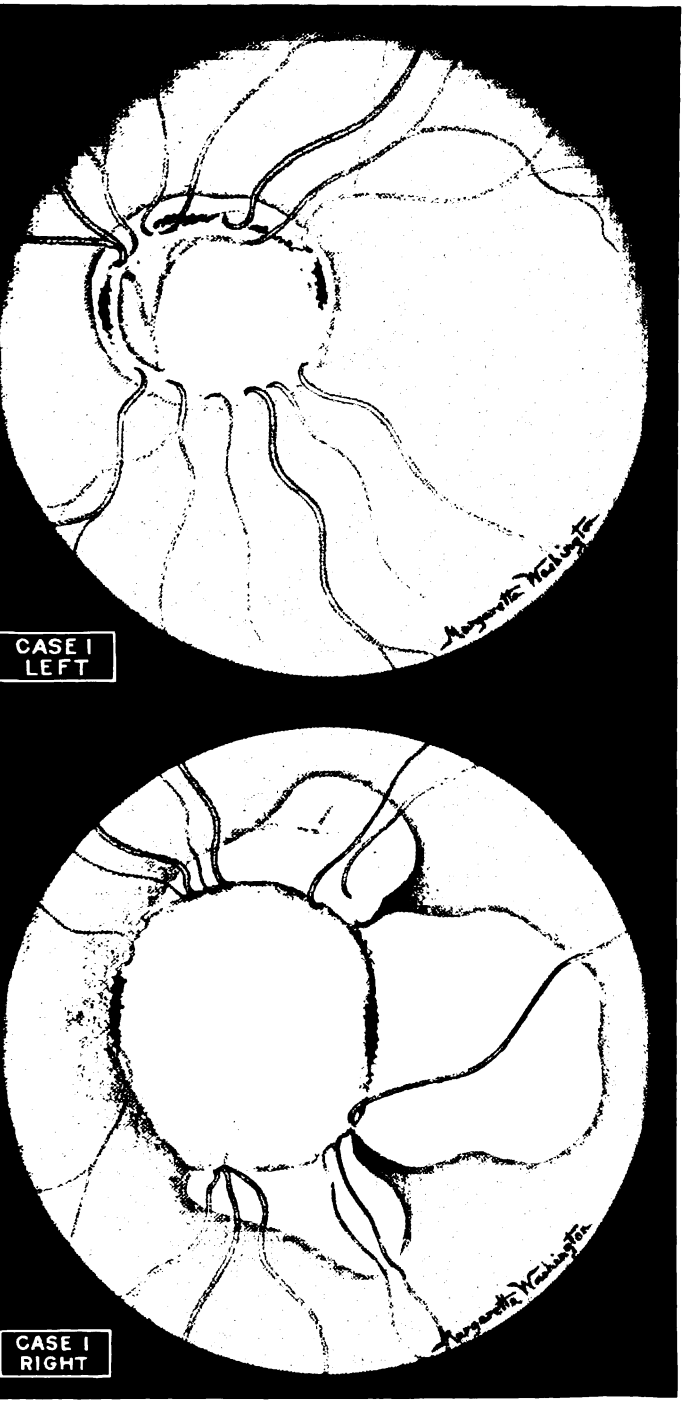
The left eye is of equal interest and is everywhere normal,

except that the disc, which is somewhat larger than usual, is transversely oval and deeply excavated. The normal retina appears to stop abruptly at a sharply defined scleral ring, which, although broader than usual, presents no marked irregularities. Within this and about the margins of the rap-



Case 1.—Left Eye. Form and Color Fields.

idly receding cavity there are scattered islands of pigment. The scleral opening is largely undercut, and the vessels, seen in the depths of the nasal side are, with one exception, lost to view before piercing the semi-transparent margins to pass to the retina in two scattered groups above and below. One branch of the deep vessel climbs diagonally up the superior wall to the upper temporal part of the fundus.



Binocular coloboma of the optic nerve.

A large main cavity extends to a certain depth, and from its floor tunnels appear to pass laterally and backward, especially on the temporal side, where one's imagination assists in picturing a beautiful, yellowish-gray grotto.

The deep vessel in the nasal side can almost be carried in the same focus with those of the surrounding fundus, but the homogeneous nature of the deeper portions prevents an estimation of their depth, which, however, is probably not excessive.

CASE 2.—Sister of Case 1, aged five years, who has had a squint since birth. The examination, in which Dr. William T. Shoemaker kindly took part, proved difficult on account of the active, lateral nystagmus. The eyes were of equal size, and, aside from a moderate inturning of the totally blind right eye, were externally normal. The fundi also appeared so, except for the following congenital changes. Both discs were replaced by deep round apertures having sharply defined and apparently undercut margins. No details were observable in the grayish, homogeneous depths. The vessels appeared about the edges of the pseudo-disc, around which they were distributed in a fairly uniform manner, no doubt being of the cilioretinal type.

There were no choroidal defects about the disc margins, but in the lower part of the right or blind fundus there were two colobomata, one of which was sharply circular and pearly white, with a diameter of about two-thirds the size of the disc. To the temporal side of this strikingly white area, and also two or three diopters from the disc, there was a slightly larger, irregular coloboma of the choroid with pigmented margins. It was impossible to secure satisfactory visual fields. V. R. E., no l. p.; L. E. = $\frac{6}{9}$ to $\frac{6}{12}$ by object tests. Although tonometric measurements were not made in either case, numerous tactile tests showed the tension to be normal.

In the excellent monograph of Coats, to which reference has been made, the reported cases are classified from the pathologic standpoint in the following three divisions:

(1) All cases in which the lesion is a coloboma of the choroid beneath the nerve, the latter being normally formed, and

sharing only passively in the deformity. To this category belong the cases of Liebreich,[12] da Gama Pinto,[13] v. Duyse (Cases 1,[14] 3,[15] 4,[16] 6[17]), Manz[1] (case 2 from the eye of a rabbit), Bock[18] (1), Gorlitz,[19] Bach,[20] Knapp[21] (1, 2, from a rabbit), Elschnig[22] (4, 5)—14 cases in all.

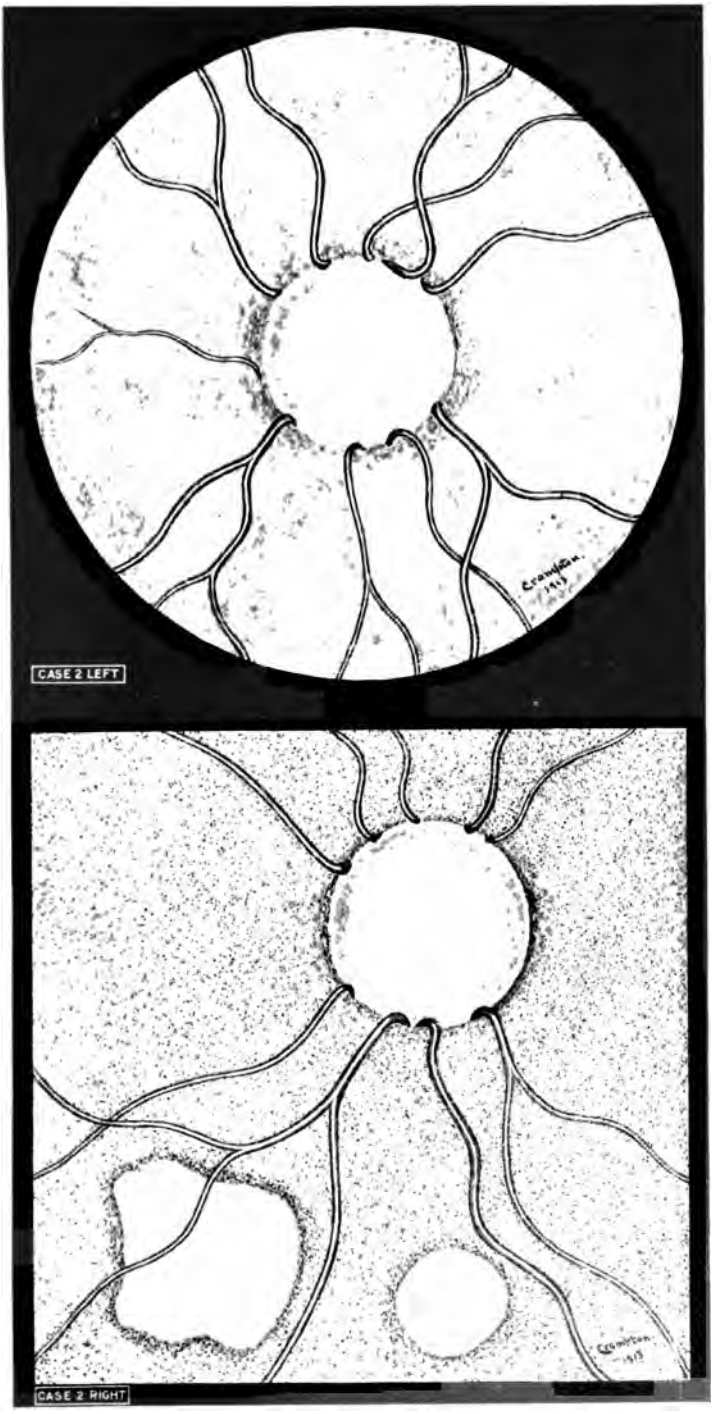
(2) Cases that show a coloboma of both the choroid and nerve. To this class belong the cases of v. Duyse (2,[15] 5[17]), Manz[1] (1), Hess[23] (?), Bock[20] (2, 3), Bach[20] (5, from the eye of a rabbit), Bernheimer[24] (probably the result of hydrocephalus secondary to leptomeningitis), Elschnig[22] (1)—9 cases.

(3) Cases in which the lesion is a coloboma of the nerve alone, the adjacent choroid being normal. To this category belong the cases of Ginsberg[25] (from the eye of a rabbit), Gorlitz,[19] v. Hippel,[26] Elschnig[22] (3?)—4 cases.

Coats gives very good abstracts of these cases, and discusses the findings very fully. He admits, however, the difficulty one encounters in attempting to classify some of the cases. For instance, it is uncertain whether those of da Gama Pinto, Hess, and Bernheimer are colobomata of the nerve or of the choroid beneath it, and also whether Elschnig's case 3 was a true congenital abnormality. Gorlitz's case appears in Groups 1 and 3 because there seemed to be two distinct abnormalities.

Including the two cases of the writer, one with an uncomplicated coloboma of the left eye and the other with both so affected, there are on record, so far as it has been possible to find, 21 cases in 16 patients. In this are included the 5 cases collected by Coats and 3 cases of Nieden, which were published prior to his paper, and which he fails to note; also the 10 which have reached the literature since that time.

Nieden[27] (1879) seems to have described the first three cases of complete colobomata confined to the nerve or its sheath, although the histologic findings were not obtainable. The three examples belonged to two persons, one of whom



Binocular coloboma of the optic nerve.

had the anomaly in two eyes. This latter was a boy, aged nine years, whose right papilla was vertically oval and nearly twice the normal diameter. The scleral rings were somewhat removed from the disc, which was of a brilliant bluish white color. The vessels were grouped largely above and below, and might be said to belong to Caspar's second classification, as those above arose from near the center of the disc. The lower ones, however, bent in a curve over the edge of the lower scleral margin, from beneath which they appeared to come. There was no defect of the choroid. On account of corneal maculæ caused by trachoma the vision could not be obtained with accuracy. After correction of the hyperopia, V = $\frac{1}{4}\frac{0}{0}$. The tension was normal.

The left eye was practically identical, except that the pseudo-disc was more depressed and the vessels arising entirely from below placed it in Caspar's first group. With this eye he could count fingers at two feet, notwithstanding the corneal opacities. In the second case, a woman aged twenty-five who also was nystagmic, there was a coloboma of the right eye, almost identical with the right eye of the foregoing case, without further fissure of the uveal tract. In the patient's other eye there existed a coloboma of the iris, choroid, and retina. Here also the vessels came under Caspar's group 2. V. R. E. = $\frac{1}{8}$ to $\frac{1}{2}$; L. E. = fingers at 16 feet. Nieden's fourth case appears to be a partial coloboma of the disc, and therefore will not be considered further than to state that there was a deep, oval, sharply defined sinus occupying the lower half of the disc in a girl aged nineteen whose eye was microphthalmic.

It is probable that the first histologic study of a coloboma of the optic nerve, where there was no directly associated defect of the choroid, was the case published by Gorlitz[19] in 1897. There is some doubt about the case, however, as there were two, probably independent, abnormalities. Coats considers the ophthalmoscopic picture of coloboma of the

nerve entrance in this case to be due to a defect, not in the nerve, but in the choroid bordering its lower edge. In addition there were defects within the nerve itself, in the lamina cribrosa; these, however, were filled in with nerve-fibers, and were perhaps invisible ophthalmoscopically. The papilla was oval and enlarged to three times its normal diameter, the whole pseudo-disc being excavated below more than above, as so often exists. The fundus was otherwise normal. The vessels entered with a sharp bend at the edge of the coloboma, except one artery and vein on the nasal side, which arose in the center. The globe was of normal size, but the cornea was small. At the junction of the sclera with the nerve below there was a bulging without sharply delimited anterior or lateral boundaries, which belonged partly to the nerve-sheaths and partly to the sclera.

Brief mention of the microscopic details, while difficult to follow without the aid of an illustration, may be of interest, as the proper classification of the case is in dispute. Microscopically, the nerve-entrance occupied somewhat more than one-half of the excavation at the posterior pole, the remainder being formed by a recess filled with densely intertwined masses of fibrous tissue. The intervaginal space, although enlarged above, was in normal relation to the surrounding structures. Owing to the formation of the ectasia immediately beneath the nerve, the entrance pointed downward. A defect in the sclera below the disc formed the entrance of a small cavity, reaching beyond the surface of the globe, which was filled with tissue of the nature of altered retina. The central vessels were present in the nerve. Somewhat below the center of the papilla there was a small but almost complete gap in the lamina cribrosa, which elsewhere was well developed. In the upper part of the lamina there was another deeper defect, at the bottom of which was an empty space.

In the following year v. Hippel[26] published a case which he

believed to be a true coloboma of the nerve not including the choroid. The case was that of an infant whose globe was of normal size and appearance. The choroid ended in the usual manner at the edge of the porus opticus, which measured 1 mm. across. Instead of being filled by the entering nerve, it was occupied by a cyst-like invagination of the retina which projected through the sclera and came into contact with the tissues of the orbit. The central vessels were absent.

A period of eight years passed before Parsons and Coats,[28] in 1906, published a case which appears to belong to the same type. Coats described this more fully in 1908 in connection with his other two cases. The specimen was obtained from a child, ten months old. A very deep coloboma at the nerve entrance, as well as a macular coloboma and an excavation on the nasal side of the papilla, could be seen with the ophthalmoscope. At the junction of the nerve with the sclera there were two cystic swellings. One on the nasal side formed an almost perfect hemisphere, while another further back appeared to hollow out the nerve itself. On dividing the globe, which was small, there was seen an exceedingly deep pit in the position of the optic nerve. The retina was not defective, and on all sides reached up to and passed into the excavation. The vessels emerged chiefly on the nasal side in several isolated trunks. All the anterior parts of the eye were normal. Parsons[9] believes there can be no doubt that in this case the cyst invading the nerve is a true "coloboma of the nerve-sheath," not an excavation of the nerve proper. On each side the sclera and choroid come to their normal terminations. This is especially well seen on the temporal side, where the intervaginal space gives a good rallying point, and just within it the sclera terminates in a sharp promontory. The choroid ends in the same position, and the retina a little further in, being dragged round into the excavation for a short distance. On the other side

the sclera, choroid, and retina also end in normal relations to one another. There is, therefore, no coloboma outside the normal limits of the porus opticus.

Coats' two other examples occurred in an anencephalic fetus born at term, and were, therefore, similar to v. Duyse's[16] case 4. Externally the globes appeared normal except for the thinness of the optic nerves. On section the papillæ did not appear to be enlarged or greatly excavated, and all the other intraocular structures were normal. At the lower edge of the nerve a deep pocket passed backward into the nerve and terminated in a blind end which destroyed the inferior half of the nerve, but the defect was entirely within its limits, the choroid and sclera taking no part in the formation. The nerve consisted of the supporting framework only, no nerve-fibers having been observed. The central vessels passed into the center of the nerve in a normal manner, but on reaching the colobomatous area they were displaced upward and entered the globe beneath the upper border of the papilla. As both eyes were almost identical only a brief general description is here given.

Lindsay Johnson[29] describes a coloboma in an intelligent lad, three and one-half years old, in whom the right eye was normal but the left remained undeveloped and smaller than the other, with a vision of mere light perception. The disc was lost in a large, egg-shaped coloboma in the inferior portion of which there was a round, mother-of-pearl-like depression nearly the size of a normal disc. The defect above was almost on a level with the general fundus, while below it was more depressed. The superior vessels terminated in the center of the coloboma, while the numerous lower ones passed in over the lower scleral margin and disappeared. Elsewhere in the fundus there was a small coloboma of the choroid.

Occasionally the normal site of the disc is occupied by an enormous, kettle-shaped cavity or cystic dilatation which

has been known to attain a size greater even than the eyeball itself. A moderate sized example of this condition is shown in the case of Hosch,[30] in a girl, aged eighteen years, who had a coloboma of both nerves without deformity of the choroid. In the right eye the scleral opening was two or three times the size of a normal disc, and expanded into a tremendous kettle-shaped cavity having sharp margins, which were irregularly undercut. No lamina cribrosa was seen. Hosch found it impossible to estimate the depth of the cavity with a Landolt ophthalmoscope. A number of fine vessels sprang from the sides of a light central area in the depths of the cavity. The left eye was similar, with a somewhat larger cavity, and up and out from the disc there was a rounded ectatic area. The vessels were similar to those of the other eye.

In a case reported by Parsons[31] the scleral aperture, while appearing to be very deep, was only 2 D. below the surrounding fundus, which was hyperopic about 4 D. The disc was very much enlarged, with all the vessels appearing at its margins, principally above and below. Elsewhere the fundus was normal. The field was almost as large as that of the right eye, in which it was quite normal, as were also the fundus and vision. V. L. E. $= \frac{6}{60}$, corrected to $\frac{6}{24}$. Tension normal.

Werner[32] examined a girl, aged nineteen, whose right eye, smaller than the left, showed a large and deep excavation having in places a pigmented border, in size about 4 disc. diam. The lower edge of the excavation was narrow and rounded, with a few small vessels curving round it. The upper wall of the excavation sloped backward from its edge for some distance, forming another and deeper excavation, while inside and to the left was another still smaller cavity. The center of the excavation was of brilliant white appearance. The whole of the disc was replaced by the excavations.

Vision was reduced to the counting of fingers to the outer side.

In the case reported by Chance,[33] a child aged six years, whose parents were unrelated, and in whose family there had occurred no ocular anomaly, was noticed in infancy to have an inturning eye and poor vision. The tension of both eyes was normal and there was no external abnormality. The left disc was irregularly circular in outline, without regular rings, and had the appearance of a slightly raised crater four times the size of an ordinary disc. A dusky white fibrous ring, crimped into more or less deepened, pigmented folds, surrounded the aperture, which indefinitely resembled a bunch of cotton-wool. Inside the rim of the pseudo-disc a narrow, deeply pigmented, shelf-like projection was seen, beyond which the cavity in the shape of a receding cone sloped regularly backward to an uncertain depth, as much as −20 D. being obtainable. No central vessels were seen, but numerous small scattered vessels crept up the sides until lost to view by the overhanging scleral aperture at the base of the cone. Over this they appeared again to pass to the retina over the raised, crater-like margin. The other eye was practically normal and there was no physiologic cup. V. R. E. = $\frac{5}{10}$, corrected to $\frac{5}{5}$; L. E. = $\frac{5}{50}$, corrected to $\frac{5}{30}$.

In a number of instances typical colobomata of the disc, in which there was no extension of the fault downward, have been associated with an equally interesting coloboma of the macula lutea, and no doubt the congenital fault in this latter position has often been mistaken for a macular choroiditis.

The changes most often met with in this location are described in the papers of Parsons,[9] Bock,[18] Hess,[23] Deyl,[34] v. Duyse, and Oeller.[35] The latter gives the details of a case which comes within the limits of the writer's series, in that a coloboma of the disc, uncomplicated with a choroidal fault adjacent to the nerve, was associated in both eyes of a young woman with a very definite central or macular colo-

boma. As might be expected, vision was reduced to: R. E. = $\frac{2}{60}$; L. E. = $\frac{3}{60}$, which her correction of —5 D. failed to improve. The fields were normal, excepting a scotoma of the right eye corresponding with the choroidal patch, and both eyes were slightly microphthalmic. The disc was slightly enlarged and excavated, while an indefinite pink ring outlined the cavity and no doubt carried the nerve-fibers. The vessels arose about the periphery. The case of Parsons and Coats, already alluded to, was also of this type, although unique in being the only one reported where, notwithstanding a macular coloboma, there remained an imperfectly formed but quite recognizable fovea. The most defective layer was the pigment epithelium, which was present only in islands and had entirely lost its pigment. A point of interest was the absence of any evidence of inflammation, no adhesions being present between the retina and the choroid. This fact is cited by Parsons as another addition to the considerable body of evidence against Deutschmann's[36] theory that all colobomata are due to inflammation in early fetal life. It seems evident, therefore, that the adhesion between retina and choroid, and the deep excavations which have been usually found in pathologic examinations of colobomata, are secondary phenomena, due to subsequent inflammation or to stretching and giving way of a weak part of the globe. Pause's[37] case confirms this view, as both the choroid and retina were free from evidences of inflammation over a coloboma of the choroid. The pigment epithelium, while present, was devoid of pigment.

Zade's[38] case is of interest, as there was binocular coloboma of the optic nerve with normal function in one eye. A blond man, aged twenty-one years, had pseudonystagmus. The right eye, in which there was an associated defect of the choroid, was divergent and myopic. —16 D. glasses failed to improve the vision. The light gray fundus merged into a narrow gray scleral ring at the sharply defined disc mar-

gin, leaving a large round scleral aperture twice the size of the other disc, the apparent dimensions being no doubt influenced by the high degree of myopia. The vessels appeared to spring from the periphery of a homogeneous gray area in the center of the cavity, and passed to the retina evenly distributed about the disc margin. Adjoining the pseudo-disc, and separated from it by only a narrow red area, there was a pale pink defect in the choroid in the shape of a sugar-loaf pointing up and out. Below and in from the disc, and almost touching it, there was a less distinct but larger curved area of lighter color than the surrounding fundus, and apparently slightly raised, as shown by the course of the vessels. Otherwise the fundus was normal.

In the left eye the defect was confined to the nerve. The vision and field were normal, which was surprising, considering the appearance of the disc, which resembled a glaucomatous cup and required a —7 D. lens to reach its depths. The disc was normal in size, well defined, and of a pronounced gray color in its funnel-like depths. The vessels were of normal caliber, and were fairly evenly distributed about the scleral aperture, over which they passed to disappear from view. The funnel-shaped cavity in the disc pointed downward and in. There were no other lesions in the fundus.

There was some doubt in the minds of those who discussed the case reported by Dor[39] whether a coloboma of the optic nerve is a congenital possibility. From Dor's description, however, there is little doubt of its being a typical case. A man, aged fifty-eight years, consulted him in regard to a beginning cataract in the left eye, the vision of which was $\frac{8}{10}$. V. R. E. $= \frac{1}{10}$. The right papilla was larger than the left and had a grayish, excavated surface, in which no vessels were visible; they appeared, however, about the periphery and spread to the retina. No mention was made of a choroidal defect.

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DISCUSSION.

DR. J. E. WEEKS, New York: The cases of coloboma of the optic-nerve sheath which I have seen have not presented the marked excavation that we find in this case. The excavation has been quite shallow at the upper margin of the disc, as a rule, and the scleral ring has not been so marked as we find it in this case. The colobomata, as a rule, are down-

ward and inward, or downward and slightly inward. I have in mind a case of congenital glaucoma in which there was no enlargement of the cornea or globe with cupping very much as presented here. This case was seen by Fuchs in Vienna, and he pronounced it a case of glaucoma occurring in early youth, perhaps congenital.

DR. EDWARD JACKSON, Denver: The only case of coloboma of the optic nerve I have seen which approached this in depth was one where the cup measured 13 D. That case I saw first twenty-five years ago. I know her history throughout life, and there is nothing in it to indicate that at any time there was increased intraocular tension. There was none when I saw her. There were also anomalies in the distribution of the vessels of that eye, but her other eye remained sound throughout life. I know the family well, and there is no similar case in any member of it. The coloboma itself closely resembled that of Dr. Crampton's; it was a little larger and certainly 13 D. deep in an otherwise slightly hyperopic eye.

DR. J. E. WEEKS: Has there been at any time any increase in tension noticed in the cases of coloboma of the optic nerve presented?

DR. GEORGE S. CRAMPTON, Philadelphia: The cases have been under my observation only a little over two weeks. The tension of both eyes was considered to be normal by a number of competent observers, but so far no tonometric measurements have been made. The size of the scleral aperture or pseudo-disc in the right eye of the boy, which appears to be about two and a half times the diameter of an ordinary disc, seems to preclude any chance of its being of a glaucomatous nature. Then, again, there are other changes: in the right fundus, for instance, of the little girl, in the lower part of which there is a perfectly circular white spot of exposed sclera, smaller in size than the disc, and elsewhere below another congenital-looking choroidal fault. Neither of these, however, approaches the disc.

THE EXPERIMENTAL PRODUCTION OF SCLERO-KERATITIS AND CHRONIC INTRAOCULAR TUBERCULOSIS.

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Three years ago I brought forward the theory that in tuberculous scleritis and keratitis the infection reached the sclera and cornea by way of the aqueous humor and ligamentum pectinatum.* The bacilli, it was assumed, passed into the aqueous humor either directly from the capillaries of the ciliary body or from small metastatic foci situated just beneath the pars ciliaris retinæ. The theory was deduced chiefly from the histologic findings in an eye with typical tuberculous sclerokeratitis in which both old and recent lesions were present. Since then I have had opportunity to examine histologically several additional cases that have given confirmation to the theory, and still more recently I have succeeded in obtaining experimental evidence which not only strongly supports this theory, but which goes to prove that chronic intraocular tuberculosis has, in general, a similar origin. It is this experimental evidence that forms the basis of the present communication.

In 1907 Stock† published the results of an investigation in which he had injected living tubercle bacilli into the ear-

* The histologic findings in a case of tuberculous cyclitis, and a theory as to the origin of tuberculous scleritis and keratitis. Trans. Amer. Ophth. Soc., 1910.

† Tuberkulose als Aetiologie der chronischen Entzündungen des Auges und seiner Adnexe, besonders der chronischen Uveitis. Graefe's Arch. f. Ophthalmologie, 1907, lxvi, p. 1.

veins of rabbits. He found almost constantly focal lesions throughout the uvea, the most notable feature of which was their tendency to heal without destroying the eye. These results have led Stock and others to attach great importance to tuberculosis as a cause of chronic uveitis in man. I have come to believe, however, that Stock's experiments were conducted under conditions so different from those obtaining in human cases of chronic ocular tuberculosis that they are of little significance in regard to the latter. In his experiments large numbers of virulent bacilli were suddenly introduced into the blood of animals presumably free from tuberculosis. In human ocular tuberculosis of the chronic type, on the other hand, the patient has previously been affected with tuberculosis, usually glandular in character, and has acquired a relative immunity which must necessarily influence the eye lesions. The importance of this difference is shown by clinical experience, for according to Stock's results the most common type of ocular tuberculosis should be uveitis, while sclero-keratitis should be exceptional, whereas in reality the latter is common while tuberculous iritis and choroiditis are relatively extremely rare. Moreover, the ciliary body was seldom affected in Stock's experiments, and when it was the lesions did not involve the inner surface of the ciliary processes, thus differing greatly from the lesions of chronic tuberculous cyclitis in man.

In only two of his animals did Stock find active scleritis. In one of these there was an extensive involvement of the sclera in the equatorial region, clearly due to direct extension from the choroid. Clinically the appearance produced was not unlike that of brawny scleritis in man, and Stock, therefore, inferred that the latter condition may result from tuberculosis. In his discussion Stock does not clearly distinguish between brawny scleritis and anterior nodular scleritis. In a recent paper* I have shown that these two

* "Brawny Scleritis," *The Ophthalmoscope*, Jan., 1913, p. 1.

conditions, both clinically and histologically, are entirely different; that, moreover, brawny scleritis begins in the sclera and only secondarily affects the uvea, and that in all probability it is due to syphilis. In the other animal Stock obtained a large caseating focus involving the corneoscleral junction and producing the clinical picture of sclerosing keratitis, which he assumed originally had extended by continuity from the anterior part of the choroid.

As I have previously pointed out, histologic examinations in human cases show that tuberculous scleritis does not arise by continuity from the uvea, as assumed by Stock. The possibility of direct metastases from the blood can also be excluded by the facts that metastases to the sclera rarely if ever occur in cases of malignant tumors, pyemia, miliary and other active forms of tuberculosis. Moreover, in case of the choroid such metastases are relatively common, so that if nodular scleritis was due to blood metastases, chronic tuberculous choroiditis should be far more frequent than tuberculous scleritis, whereas the reverse is true. This argument is strengthened by Stock's large series of experiments just referred to, in which the choroid almost invariably showed metastatic foci, while the sclera was affected in no more than three animals and here apparently not by direct blood metastases. Extension from the uvea and direct metastasis from the blood thus being excluded, the only remaining possibility would seem to be that anterior nodular scleritis in man is due to metastases through the filtration angle from the aqueous humor, and this origin I have shown to be clearly indicated by the histologic findings in enucleated eyes.

In endeavoring to test experimentally this theory, it obviously would not be practical to attempt to reproduce all the conditions occurring in human cases. For, granting the possibility of producing a systemic chronic tuberculosis similar to that in man, the percentage of animals that could

be expected to develop scleritis would be far too small. On the other hand, the attempt to produce tuberculous scleritis by introducing live virulent bacilli into the vitreous chamber would also be impractical, because an active intraocular tuberculosis would ensue before scleritis could develop. In human cases it is clear that, since the lesions are of a mild type and ultimately always heal, the bacilli must be relatively inactive. It occurred to me, therefore, that for experimental purposes dead bacilli might serve, and, as will be seen, this has proved to be the case.

In the following experiments bacilli from a three-weeks'-old culture of virulent human tubercle bacilli on glycerin agar were used. They were killed by exposure to ultraviolet light, although the same results no doubt could be obtained with bacilli killed by heat. Two loopfuls of bacilli were stirred into 2 c.c. of distilled water and then exposed for ten minutes to the light of a Cooper-Hewitt quartz mercury vapor lamp (220 volts, 3.5 amperes) without the globe, at a distance of 20 cm. This suspension was drawn up through a fine needle into a hypodermic syringe, and a few drops then injected through the sclera or into the anterior chamber as desired. Thus no attempt was made accurately to adjust the dosage. In three eyes no lesions resulted, due possibly to large clumps of bacilli lodging in the needle and preventing a sufficient number of bacilli entering the eyes.

EXPERIMENT 1.—Injection of dead tubercle bacilli into vitreous humor of left eye of rabbit.

After seven weeks a minute spot is seen on the surface of the iris. There are no scleral nodules, and the eye is free from congestion. Enucleation.

Macroscopic Examination.—In addition to the spot on the iris, an elevated spot beneath the retina corresponding to the puncture wound, and a tubercle in the fundus, 1 mm. in diameter, are seen.

Microscopic Examination.—The iris shows a few small

tubercles on its surface and within the stroma, besides the large one seen macroscopically. The relative scarcity of lesions in this eye is evidently due to injection of fewer bacilli than in subsequent experiments. Numerous tubercles are found in the ligamentum pectinatum. These are too small to involve the sclera to any extent, but some of them extend into the subchoroidal space. They occur above as well as below, but are largest below. They, as well as the iris tubercles, consist of endothelial cells with occasional giant-cells, but show no caseation. They contain from one bacillus in three fields to three bacilli in one field. The surface of the ciliary body is almost free from tubercles, but a few minute tubercles are seen on the orbiculus ciliaris, one of which has destroyed the epithelium. One small tubercle is found free in the anterior part of the vitreous, made up of endothelial cells free from necrosis. Two others, each about 0.2 mm. in size, are seen in the posterior part of the vitreous near the retina. The latter are almost completely necrotic, and surrounded apparently by young connective-tissue cells.

At the site of the puncture wound there is a tubercle without caseation which involves chiefly the choroid. The tubercle of the retina in the fundus involves mainly the outer retinal layers, destroying the pigment epithelium and the inner layers of the choroid, and leaving the inner layers of the retina intact. It is free from caseation. The surrounding choroid is infiltrated with plasma and lymphoid cells. The tubercle contains only a few bacilli. At the equator below there are two small tubercles on the surface of the retina, and the latter in this region is giving off a considerable exudate of pus cells.

In juxtaposition to the optic disc the choroid shows a large tubercle, over which the pigment epithelium and retina are intact. This was probably due to metastasis from the large retinal tubercle a short distance away from it. A few minute choroidal tubercles are also seen elsewhere in the fundus.

EXPERIMENT 2.—Injection of dead tubercle bacilli into vitreous humor of rabbit's eye (Figs. 1, 3, and 7).

Eleven weeks later the eye is still perfectly free from congestion, but the iris shows numerous small white spots,

irregular in shape, the largest being 0.75 mm. in diameter. The cornea is clear. At the limbus on the outer side there are three elevated nodules, and on the inner side there are also three. The largest is 2.5 mm. in diameter, and extends 0.25 mm. into the cornea. The others are each about 0.75 mm. in diameter, and situated 0.25 mm. from clear cornea. Directly below there is a single nodule, 2.5 mm. in diameter, which is more elevated than any of the others. It has an opaque center with translucent periphery. Enucleation.

Macroscopic Examination.—The inner surface of the ciliary body shows 14 irregular shaped white spots, not elevated, the largest 2 mm. in diameter, situated just behind the ciliary processes. The retina and choroid are *in situ*, and show in the lower quadrant 14 elevated round spots with opaque centers, and a single similar spot in the upper outer quadrant. The vitreous humor is clear.

Microscopic Examination.—Only a few small tubercles happen to be encountered in the iris. These are usually near the anterior surface at the pupillary margin or near the root. None is seen on the posterior surface. The white spots seen on the inner surface of the ciliary body macroscopically are found to be tubercles in the filtration angle showing through. The smallest tubercles are centered in the ligamentum pectinatum; some of the largest ones sometimes involve chiefly the sclera and cornea, others also the ciliary body. Most of them show caseous centers containing about 2 bacilli in a field. No clumps of bacilli are seen here. Extending out from the large tubercle below, the cornea is infiltrated and vascularized for a considerable distance, but only superficially. On the posterior surface of the cornea here and there occur small nodules of endothelial cells.

Several small tubercles are seen in the vitreous humor in the vicinity of the ora serrata. These are made up of branching cells and are surrounded by capsules of young connective tissue. Some are slightly infiltrated with pus-cells, but they show no caseation.

The elevated spots in the fundus are found to be tubercles situated between the choroid and retina and involving both of these structures (Fig. 7). The rods and cones, and to a less extent the nuclear layers, are replaced by a caseous mass

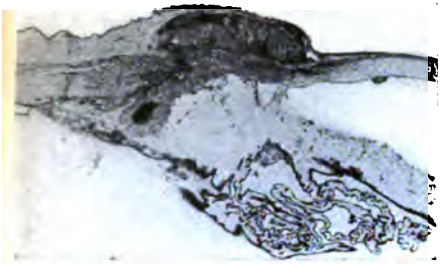

Fig. 1.—Experiment 2. Sclerokeratitis due to dead bacilli introduced into vitreous of rabbit. Note also minute tubercle on membrane of Descemet.

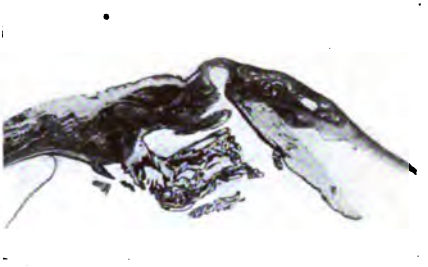

Fig. 2.—Experiment 5. Sclerokeratitis due to dead bacilli introduced into anterior chamber of immunized rabbit. Note also intercalary staphyloma and small tubercle of iris.

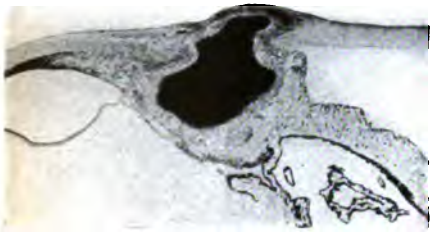

Fig. 3.—Experiment 2. Caseating tubercle involving ciliary body and sclera, due to dead tubercle bacilli introduced into vitreous of rabbit.

Fig. 4.—Experiment 3. Caseating episcleral tubercle and large tubercle of ciliary body, due to dead bacilli introduced into anterior chamber.

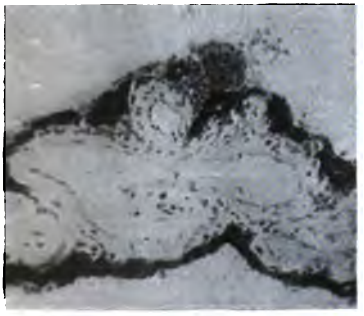

Fig. 5.—Experiment 5. Small tubercle making its way through epithelium of ciliary body from without.

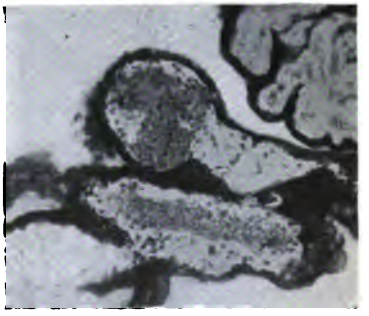

Fig. 6.—Experiment 5. Small tubercle entirely within ciliary process. This evidently originated outside the process, as indicated in Fig. 5.

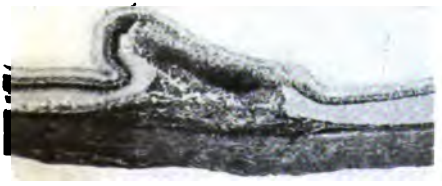

Fig. 7.—Experiment 2. Caseating tubercle of retina due to clumps of dead tubercle bacilli which have passively entered the retina from the vitreous.

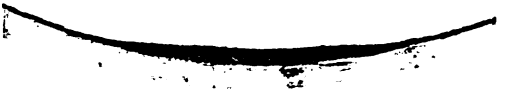

Fig. 8.—Experiment 3. Tubercle of choroid due to dead tubercle bacilli introduced into anterior chamber, which have passed along the subchoroidal space.

containing necrotic pigment cells and pigment granules. Behind this the pigment epithelium is destroyed, and from the inner layers of the choroid an exudation of endothelial cells is taking place. Deeper down and at the periphery of the tubercle the choroid is richly infiltrated with plasma cells. Within the caseous mass fairly numerous tubercle bacilli occur, usually singly, rarely in small groups. Tubercle bacilli are also found free in the intact retina over the tubercle.

EXPERIMENT 3.—Injection of dead tubercle bacilli into anterior chamber of rabbit's eye (Figs. 4 and 8).

After twelve weeks the eye shows slight pericorneal injection and the pupil is somewhat contracted. There are numerous tubercles on the iris, and two scleral tubercles near the limbus below, 5 mm. apart. Each of the latter is about 1 mm. in diameter externally. Enucleation.

Macroscopic Examination.—In the choroid a single white spot, not appreciably elevated, is found 1 mm. below the medullated streak and 8 mm. from the disc. There are no tubercles of the retina.

Microscopic Examination.—A large tubercle almost completely caseous is found replacing the ciliary body and root of iris below. It contains numerous bacilli, some of them in large clumps. In front of this, but not in direct continuity with it, there is a smaller tubercle in the episcleral tissue, corresponding to one of the tubercles seen before enucleation (Fig. 4). This also has a caseous center and contains numerous discrete bacilli, but no clumps. The cornea in this region shows a marked infiltration and is richly vascularized. The infiltration reaches almost to the pupillary area. There are no foci of epithelioid cells in the cornea, the reaction evidently being due to toxins diffused from the tubercle in the ciliary body. On the posterior surface of the cornea there are nodules of endothelial cells. The filtration angle shows smaller tubercles elsewhere, but none above.

The iris shows numerous minute tubercles, most of them on its surface, but some also within its stroma.

A few minute tubercles are found below, on and within the ciliary processes, as in experiment 5. These are no doubt due to bacilli which were carried into the aqueous

humor from the large tubercle of the ciliary body and deposited on the ciliary processes.

The choroid below shows a few discrete foci of endothelial cells leading away from the filtration angle. The white spot in the choroid seen macroscopically is found to be a flat tubercle 2 mm. in diameter (Fig. 8). It does not involve the retina, and consists of epithelioid cells in the deepest layers of the choroid with lymphoid cell infiltration of the choriocapillaris. This tubercle contains very few bacilli, no more than one being found in any section examined.

EXPERIMENT 4.—Injection of dead tubercle bacilli into vitreous humor of left eye of rabbit which had healed tuberculosis of right eye. The right eye had been inoculated with the bacillus of lupus two years previously and was in a state of phthisis bulbi free from inflammation.

Within one week the left eye showed a severe inflammatory reaction, with iritis. This rapidly subsided. Enucleation at end of five weeks.

Microscopic Examination.—The anterior part of the vitreous humor is solidly infiltrated with necrotic pus cells which show a nodular arrangement around clumps of tubercle bacilli. Posteriorly the vitreous is infiltrated chiefly with serum. The retina is separated almost everywhere, and is giving rise to a marked exudation of pus cells but no endothelial cells. From the ciliary body granulation tissue is making its way into the infiltrated vitreous. Upon and beneath the surfaces of the ciliary processes minute foci of endothelial cells are sometimes seen, similar to those in experiment 5. The pupil is occluded by membrane. The iris shows a few tubercles on its surface and within the stroma. The filtration angle shows numerous tubercles which are usually closed off by adhesions of the root of the iris to the cornea. These are largest below. The cornea for a considerable distance from the limbus, both above and below, is vascularized and infiltrated in its superficial layers, but it contains no tuberculous foci.

The choroid shows numerous small nodular infiltrations with plasma cells containing occasionally central foci of endothelial cells, and at the equator a large tubercle, 1.5 mm. in diameter, to which the retina is adherent. This

tubercle is made up of endothelial cells surrounding a central area of necrotic pus cells. The latter does not represent actual caseation; in fact, caseation is absent from all the lesions in this eye.

In the main mass of exudate within the vitreous, bacilli are found only when in clumps, and these stain so feebly that they are visible simply because they are massed together. No bacilli are found in any of the other lesions except in the large tubercle of the choroid, in which a few poorly stained bacilli can be seen.

EXPERIMENT 5.—Injection of dead tubercle bacilli into anterior chamber of left eye of rabbit which had healing tuberculosis of right eye. The right eye had been inoculated with the bacillus of lupus five months previously (Figs. 2, 5, and 6).

Two days later the left eye was congested, there was some exudate in the anterior chamber, and the corneal puncture wound was infiltrated. This active reaction began to subside after one week. After one month there was a vascularized tubercle at the site of the corneal puncture and several tubercles at the pupillary margin of the iris.

After two months there was very little congestion, the corneal tubercle was smaller, and there was a large nodule at the limbus below.

After four months the corneal tubercle is apparently healed, the pupil is dilated, leaving numerous tubercles at the end of synechiæ on the lens surface. The eye is almost free from congestion. The nodule below is 5 mm. in diameter, and involves the sclera and cornea. Enucleation of left eye.

Microscopic Examination.—There are numerous tubercles of the iris, most of them small, on the surface and within the stroma. About them there is considerable infiltration with plasma cells, but no pus cells. Foci of endothelial cells are found in the filtration angle here and there, but there is scleritis only below. Here there is a large conglomerate tubercle involving the sclera and cornea, but affecting the ciliary body very little. The sclera has been weakened, so that there is a small intercalary staphyloma, and it shows more involvement superficially than deeply. The cornea

also is mainly involved in its outer layers. There is a deep discrete focus, however, which originally had evidently extended outward from the ligamentum pectinatum, that has undermined and curled up Descemet's membrane. There is marked plasma cell infiltration around these foci, but no purulent infiltration except in the centers of one or two. A few endothelial nodules are seen on the posterior surface of the cornea.

On and within the ciliary processes a number of minute foci of endothelial cells are found below. These are situated sometimes on the tips of the processes, sometimes on their sides, but none is seen in the sulci between them. Some of them are entirely within the stroma and covered with intact epithelial layers (Fig. 6), others are entirely on the surface, and still others partly within and partly without the surface, the epithelium here being broken through (Fig. 5).

The choroid shows a number of flattened foci, some of them occurring even posterior to the equator. Each consists of a few central endothelial cells surrounded by a dense zone of plasma cells.

The tubercles in this eye present a somewhat different picture from those of shorter duration in the previous experiments. Here, instead of the endothelial cells being round and discrete, with single nuclei, most of the cells are irregular in shape, many of them multinucleated, and are united with each other by processes, thus forming a syncytium. In the interstices Van Gieson's stain shows connective tissue making its way from the periphery, accompanied by connective-tissue cells. None of the lesions shows caseation. Tubercle bacilli are seldom found, none being seen in the small foci, such as those in the iris, and after a long search only one or two poorly stained discrete bacilli in the scleral tubercle. A few clumps of bacilli, however, are found in the latter.

The above experiments show that, when dead tubercle bacilli in sufficient numbers are introduced into the vitreous or anterior chamber of a rabbit, many are carried to the filtration angle, where, after about three months, they pro-

duce nodules in the corneosclera closely simulating those of sclerokeratitis in man. At the same time lesions are produced in the iris and choroid, and, in case of injection into the vitreous humor, also in the retina. Usually the ciliary body is involved along with the sclera, and this constitutes the chief difference between the experimental scleritis and the natural disease. This difference is probably due to the fact that the size of a lesion produced by dead bacilli is dependent upon the number of bacilli present at its inception, whereas in case of the natural disease, presumably due to living bacilli, the size of the lesion is dependent upon the suitability of the soil for the proliferation of the bacilli. Thus, in the latter case, the living bacilli, finding no doubt the cornea and sclera, owing to their poor blood-supply, especially favorable for their growth, involve these structures almost exclusively. In spite of these facts, however, in several instances lesions of sclerokeratitis occurred in the experiments with practically no involvement of the ciliary body. No discrete foci occurred in the cornea away from the limbus, evidently because dead bacilli could not be carried into the cornea in sufficient numbers.

In both size and number the lesions in the filtration angle and sclera were much greater than any other lesions in the eyes, showing that more bacilli lodged here than elsewhere. They did not occur exclusively below, as might have been expected, but where the bacilli were introduced into the vitreous humor were more numerous laterally, and some small ones occurred directly above. This fact tends to nullify the objection to the theory previously pointed out by me, namely, that the nodules in human cases are more frequent above than below. In the case of the natural disease the bacilli, of course, could not occur in such large clumps, and hence would have less tendency to settle to the bottom of the anterior chamber. It is not necessary to assume that the bacilli were carried from the vitreous humor

by the actual flow of fluid, since their transition may have been due to the frequent movements of the eyes. In the experiments in which the bacilli were introduced directly into the anterior chamber, the scleral nodules always developed below, due evidently to the fact that the clumps of bacilli did not have time to disintegrate to any great extent.

The tubercles of the iris in these experiments occurred most commonly near the pupillary margin. They were most often on or just beneath the anterior surface, though occasionally one was seen deeply seated in contact with the pigment layers. Tubercles similar to those on the anterior surface of the iris were also found on the posterior surface of the cornea.

The tubercles of the retina, seen in experiments 1, 2, and 4, are probably of no great significance in regard to human ocular tuberculosis, the conditions under which they occurred being too far abnormal. They were undoubtedly due to bacilli which penetrated the retina from the vitreous humor. They are of interest in showing how slightly the retina reacts to tubercle bacilli, single bacilli and even clumps having passed through the retina to the pigment epithelium before causing lesions, which, moreover, destroyed the outer retinal layers only. The cells forming the tubercle were derived chiefly from the choroid. In the natural disease such foci would not often occur, because the bacilli would be carried to the anterior chamber rather than into the relatively solid vitreous. In two cases of tuberculous cyclitis, however, I have seen tubercles of the retina, one of them of considerable size, which were probably due to bacilli deposited from the vitreous. Of still less practical significance were the small tubercles found on the surface of the retina in these experiments, and others occurring isolated in the vitreous humor.

Of greater import were the tubercles of the choroid which did not involve the retina. These occurred chiefly in the

anterior part of the choroid, but occasionally also in the fundus (Fig. 8). In the experiments in which bacilli were injected into the vitreous humor and retinal tubercles resulted, it is conceivable that the choroidal tubercles were due to metastases from them in the post-choroidal space. This explanation is not possible, however, where the injections were made into the anterior chamber, for retinal tubercles were absent. Here it is certain, excluding the remote possibility of blood metastasis, that the choroidal foci were due to bacilli carried from the filtration angle in the post-choroidal space. These experiments strongly indicate, therefore, that the choroidal lesions sometimes seen in cases of human scleritis are produced in the same way and are not blood metastases. They also suggest the possibility, at least, that this is true also for the majority of the relatively benign forms of tuberculous choroiditis.

The fact that dead tubercle bacilli can produce tubercles is, of course, well known, and need not be discussed here at length. The smaller experimental lesions show essentially the same histologic character as I have found in the lesions of human cases of tuberculous scleritis and keratitis. Both consist at first of discrete endothelial cells which later unite by processes forming a syncytium into the meshwork of which connective tissue makes its way. In the human lesions caseation almost never occurs, and in the experimental lesions it occurs only in the largest tubercles in which bacilli are present in excessive numbers. Langhans' giant-cells are found with about equal frequency in both. In the smaller experimental lesions remarkably few bacilli are often found, in single sections of a lesion sometimes none being seen. This fact makes it less difficult to understand why bacilli are most often impossible to find in human lesions.

These experiments, of course, do not throw any direct light on the question as to just how the bacilli reach the aqueous, as we may now assume they do, in human cases of

chronic ocular tuberculosis. In the case of scleritis already referred to, I found focal lesions on and just beneath the pars ciliaris retinæ, and assumed that these were the sources of the bacilli causing the active scleritis. It was clear, however, that the older corneal and scleral lesions in this case could not have been due to them, and this, with the fact that in certain other cases ciliary lesions were absent, led me to believe that the bacilli might pass into the aqueous from the vessels of the ciliary body without producing any lesions in their transit. The results of the present experiments now suggest this to be the rule instead of the exception, and that, when focal lesions on the ciliary body occur, such as just noted, they do not represent direct metastases from the blood but are due to bacilli or infected cells which have been deposited from the aqueous. For, in some of these experiments, minute tubercles were found both upon and even entirely beneath the epithelium of the ciliary body processes. Those beneath the surface were clearly due to groups of endothelial cells which had broken through the epithelium, the latter then reforming over them, for all stages in this process could be made out. Had these small foci contained living tubercle bacilli, they would have grown to larger size. These observations thus make it seem more than probable that the most common types of tuberculous cyclitis and iritis, even when not associated with scleritis or keratitis, are also due to bacilli or infected cells deposited from the aqueous humor.

The two experiments in which dead tubercle bacilli were injected into eyes of rabbits previously immunized to tuberculosis gave some interesting results which may further explain the difficulty of demonstrating bacilli in human cases of chronic ocular tuberculosis. The immunization was accomplished by infecting one eye of each rabbit with the living bacilli of lupus. When dead bacilli were injected into the vitreous of the normal eye, they quickly caused it

to become infiltrated with pus, a reaction no doubt analogous to that of the v. Pirquet test. The purulent exudation soon ceased and the pus became necrotic, but the bacilli evidently became free from it and were carried to the anterior chamber, since endothelial tubercles were produced on the iris and filtration angle as in the case of non-immune animals. When the bacilli were injected into the anterior chamber directly, they likewise gave rise to a prompt and severe pyogenic reaction, which quickly subsided, and later produced tubercles as usual. But the fact of especial significance in these two experiments was that most of the bacilli lost their acid-fast properties, due, probably, to the action of the animals' immune serum. Thus, except in the clumps where they were visible on account of being massed together, almost no bacilli could be found, the few seen after prolonged search staining poorly. In spite of this, lesions were produced equal in size to those of the other experiments in which the bacilli were still demonstrable. It must be noted, however, that even in the latter a small proportion of the bacilli stained feebly. It is conceivable also that in all the experiments lesions were due in part to non-acid-fast bacilli introduced from the original cultures.

A fact now well established is that the aqueous humor is relatively free from immune substances, except when as a result of paracentesis or an active intraocular inflammation it becomes mixed with serum. This may be of considerable importance in regard to the origin of chronic ocular tuberculosis, for, if living bacilli should reach the aqueous, it is obvious that they would not be held in check as in the blood or tissues, and hence might proliferate. Should they do this it would greatly increase the chances for metastases to occur in the sclera or elsewhere. Moreover, owing to the large number of bacilli present, the lesions would tend to progress even though the bacilli were soon killed or inhibited by the immune substances reaching them in their new locations.

This may explain the resistance of the lesions to treatment in spite of the fact that they ultimately always heal. The fact that tubercle bacilli cannot be demonstrated in the lesions is no argument against this view, since, as just explained, their acid-fast property may have been destroyed by the action of the immune serum to which they were finally subjected.

The foregoing considerations are suggestive in regard to the treatment of chronic ocular tuberculosis. In the first place they suggest that frequent paracentesis of the cornea would be advantageous in all cases, including cases of iritis as well as of scleritis and keratitis, since it would bring immune serum in contact with the intraocular lesions and probably also with those of the cornea and sclera. They also suggest the advisability of local treatment of the corneal and scleral lesions. This could be accomplished by means of the knife, actual cautery, or possibly by injections of strong antiseptics.* Although these latter procedures would result in a certain amount of scarring, this should ultimately be less than if the lesions were allowed to progress without such interference.

CONCLUSIONS.

When dead tubercle bacilli are injected into the vitreous humor or anterior chamber of a rabbit they produce, after about three months, lesions in the corneosclera closely analogous to those of tuberculous sclerokeratitis in man. Smaller tubercles are produced on and within the iris, and still smaller ones on and within the ciliary processes. The latter are of special significance, as they indicate that the foci in human cases of tuberculous cyclitis are not necessarily due to direct metastases from the blood. Tubercles of the

* Experiments that I have recently made on rabbits' corneæ indicate that Lugol's solution (1 : 2 : 100) is effective for this purpose, and that it causes remarkably slight scarring. It is also effective for other localized infections of the cornea.

choroid are also produced, due to bacilli passing from the filtration angle along the post-choroidal space.

These observations confirm the theory previously advanced that tuberculous scleritis and keratitis are due to infection from the aqueous humor through the filtration angle. They also strongly suggest that the chronic types of tuberculous iritis and cyclitis, and possibly choroiditis, are likewise due to metastases from the aqueous humor, the bacilli reaching the latter from the vessels of the ciliary body. The lack of immune substances in the aqueous humor no doubt increases the chances for such metastases to occur. In addition, these observations suggest certain procedures in regard to treatment.

DISCUSSION.

DR. GEORGE S. DERBY, Boston: Dr. Verhoeff's experiments suggested the possible benefit of puncture of the anterior chamber in these cases of tuberculosis of the anterior segment of the eye. Acting on his suggestion, I have carried that out now a number of times. On one case with beginning infiltration in the cornea following a very marked scleritis I have done the puncture four times on the same case, and apparently the process of the disease has been entirely arrested. I have done it twice on another case and once on one or two others, and it certainly seems as if it were a procedure of value. It is a very small operation. There has never been any severe reaction from it, and the next day the eye is no more inflamed than before the puncture was done, and very often it is less inflamed.

ON SOME FORMS OF RETINAL TUBERCULOSIS.

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In addition to the cases of retinal periphlebitis,* which occur in adolescents and in which hemorrhages, either retinal or vitreous, predominate the clinical picture, and to the cases of deep massive retinal exudation, which resemble somewhat the retinitis exudativa as described by Coats, there is a group of retinal lesions in the tuberculous where the process seems to be localized in the more superficial layers of the retina. Illustrative of this condition, I wish to report on the two following cases:

CASE I.—A. C., nineteen years old, was seen on October 29, 1912, because the sight in the right eye had been blurred for several days. He was a well-built, healthy appearing young man, who had been working in a lumber-yard and had had no particular illness. He was admitted to the hospital on November 6th. V. O. D. $=\frac{5}{200}$, central scotoma; O. S. normal; urine normal, physical examination negative, Wassermann and luetin tests negative. The ophthalmoscope showed a swollen and inflamed optic disc; the swollen nerve-head seemed to be displaced by an ill-defined chorioretinal area up and in, surmounted by a small hemorrhage (inverted image). Up and out next to a blood-vessel there was a superficial round white focus; another smaller though similar patch was to be seen below, a short distance from the disc. The macular region was occupied by a perfect star-like radiating figure; the spokes were composed of glistening, silvery interrupted lines.

As there was no fever, a diagnostic injection of old tuberculin was given. After 3 mg., the temperature rose to

* "*Archives of Ophthalmology*," vol. xlii, No. 1, 1913.

Fig. 1.

Dr. Knapp's Case of Tubercle at Optic Disc showing local reaction after diagnostic tuberculin injection.

100.4° F., with a distinct arm reaction. On examining the fundus, two days later, November 15th, many small, round, white areas were seen about the disc and the large retinal focus (Fig. 1); these were all deeply placed in the retina and distinctly under the retinal vessels. The regular tuberculin treatment with the bacillary emulsion was then begun by Dr. E. Török. November 20th the swelling about the disc has disappeared enough to disclose a circumscribed white area about one-half the diameter of the disc. This was superficially placed in the retina. More small white areas had appeared in the direction of the macula. The radiating lines about the macula were thicker and some had changed to irregular exudates. After another week the exudates, both the large and the many small ones, began to be absorbed; they grew fainter and smaller. On December 25th the main focus was nearly gone, and a distinct connective-tissue formation in the retina in this situation was taking place. Many of the small foci had disappeared. The macular figure was reduced to a few radiating lines and irregular patches. On January 24th the small foci had disappeared without a trace; connective tissue indicated the site of the previous large retinal exudation. In the macula there were a few shiny dots and irregular areas. On March 7th nothing remained in the macular region except some shiny dots and some superficial pigmentary changes. The vision had improved to $\frac{15}{200}$, but there remained a central scotoma.

The large exudate near the disc is not an example of the well-known choroidal process which, when situated near the disc, causes so much optic neuritis as to mask the choroidal origin of the process and which recently has been called chorioretinitis juxtapapillaris by Jensen. The process was always superficial, there never were any choroidal changes, it healed with the formation of superficial retinal connective tissue. This distinctly retinal exudate resembles the picture of tubercle in the retina, such as is beautifully illustrated in Adam's recent "Ophthalmoskopischer Atlas," p. 88. The star figure in the macula did not resemble the

macular changes which are observed in albuminuric retinitis where the radiating lines are composed of much heavier, more intensely white exudates like "spattered paint." In this case they were glistening, delicate, silvery, like those observed in optic neuritis. Star-shaped changes in the retina are rather the expression of a lesion in definite layers of the retina, than the characteristic of certain diseases.

The crop of small white exudates, like miliary tubercles, appearing after the diagnostic tuberculin injection, is particularly interesting. These dots are frequently observed in various forms of retinal tuberculosis, and are often situated at the periphery of a large tuberculous chorioretinal focus (see Haab's "Ophthalmoskopie," p. 80). It is uncertain whether the tuberculin injection made these small foci ophthalmoscopically visible, or whether they represent the dissemination of the original focus. The rapid and continuous improvement under specific tuberculin treatment (no other treatment was purposely given) confirms the diagnosis of a tuberculous lesion.

CASE II.—A. F., twenty-two years old, was seen on October 24, 1912, because of failing sight in the right eye, which had existed for one week. The patient had never been seriously ill; family history and physical examination negative. The Wassermann test was negative and the urine was normal. V. O. D. $=\frac{8}{200}$, central scotoma extending temporally to the blind spot; O. S. normal. The ophthalmoscope showed a white exudate composed of rounded areas which surrounded the course of a macular vein (Fig. 2). This vessel was unevenly dilated, and there were two small hemorrhages on the exudate. The 3 mg. diagnostic tuberculin injection was followed by a temperature of 100.6° F., with an arm reaction, but no definite ocular reaction except increased vitreous haze. The regular tuberculin treatment was begun on November 3d, and the patient was kept in bed. No other treatment was instituted. The exudate steadily enlarged by the formation of rounded and slightly

Fig. 2.
Dr. Knapp's Case of Exudative Retinitis.

prominent foci along the distribution of the vessels. From the macular region the process passed up and out to the superior temporal vein, then under and along this vein, spreading from day to day, back to the disc, then up along the distribution of the superior nasal vessels. The rounded exudates were always situated beneath the retinal vessels. The surrounding edema and swelling were sometimes so great as to suggest a retinal detachment. Small hemorrhages were often present on the exudates. The vitreous became very clouded, but there never was any evidence of a choroidal process. The veins generally showed no particular change; they were more defined against the white background and somewhat fuller than normal. As the process extended, the earlier exudates split up, grew smaller, and became absorbed, to leave distinct connective-tissue changes in the retina. On December 13th, two months after the beginning, no new exudates formed. The absorption and transformation to connective tissue progressed slowly, and on March 5th only two exudates were still visible, and these were reduced one-half in size. Along the superior temporal and nasal veins partial choroidal depigmentation had taken place. On April 21st, V. $=\frac{18}{20}$, with central scotoma. The ophthalmoscope showed a healed process, a clear vitreous, connective-tissue changes in the retina, and some superficial choroidal depigmentation in the distribution of the former retinal exudation.

This was unquestionably a retinal process. As the exudations formed, it could be seen that the larger patches were composed of several irregularly rounded, smaller areas. They were situated beneath the retinal vessels, often accompanied by small striated hemorrhages. As they healed, typical retinal sclerosis occurred. In some places the inflammatory process was extensive enough to cause a superficial choroidal depigmentation, but nowhere was the usual choroidal atrophy observed with pigment proliferation.

In my opinion, this case was also tuberculous, and considering the extent and severity of the process, the outcome must be regarded as very favorable, for which the specific tuberculin treatment was probably in great part responsible.

TWO UNUSUAL ORBITAL CONDITIONS.

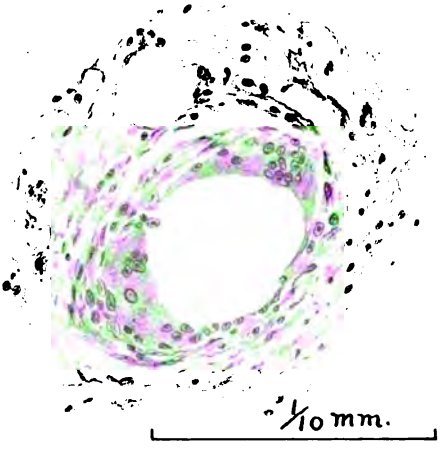
WM. CAMPBELL POSEY, M.D.,

Philadelphia.

CASE 1.—Chronic inflammatory tumor, with cyst and giant-cell formation in the floor of the orbit, and connected with the lacrimal sac, arising after false passages of lacrimal probes.

In February of this year the writer was consulted by Mrs. Z. on account of a peculiar swelling below the eyeball, which she claimed had arisen in consequence of the forceful passage of probes into the lacrimal duct, this operation having been performed about a year previously to relieve a persistent watering of the affected eye. Following the passage of the probes there had been marked swelling of the lids, and the lids and skin adjacent to them had been discolored for weeks by the blood which had invaded the tissues under the skin. As soon as the pain consequent upon the trauma of the operation had subsided, the patient noticed that much of the swelling could be made to disappear by firm pressure, and she averred that this phenomenon was attended by a peculiar crackling sensation. Although the discoloration disappeared after a time, the swelling and crackling sensation elicited by pressure remained, and she soon noted that the former began to assume a definite shape, taking the form of a more or less rounded kernel at the inner angle of the eye. She noted, too, that the swelling was not always of uniform size, being larger in the morning and growing smaller during the day, and also apparently enlarged by exertion. Blowing the nose did not seem to increase its volume. The mass was always larger when she lay down and at the menstrual epoch. In spite of various local applications prescribed by several oculists, the mass slowly increased in size, occasioning considerable disfigurement. It was in this stress that the patient consulted the writer, expressing her

Case I, Plate I.—Low-power drawing, showing large and small cysts surrounded by loose connective tissue. Some of the smaller cysts are partially obliterated by granulation tissue, while the larger cysts are free from contents and have thin walls.



Case I, Plate II.—High-power drawing of a small cyst, showing compressed giant-cells lining the walls.

readiness to undergo whatever radical treatment was necessary for the relief of the condition.

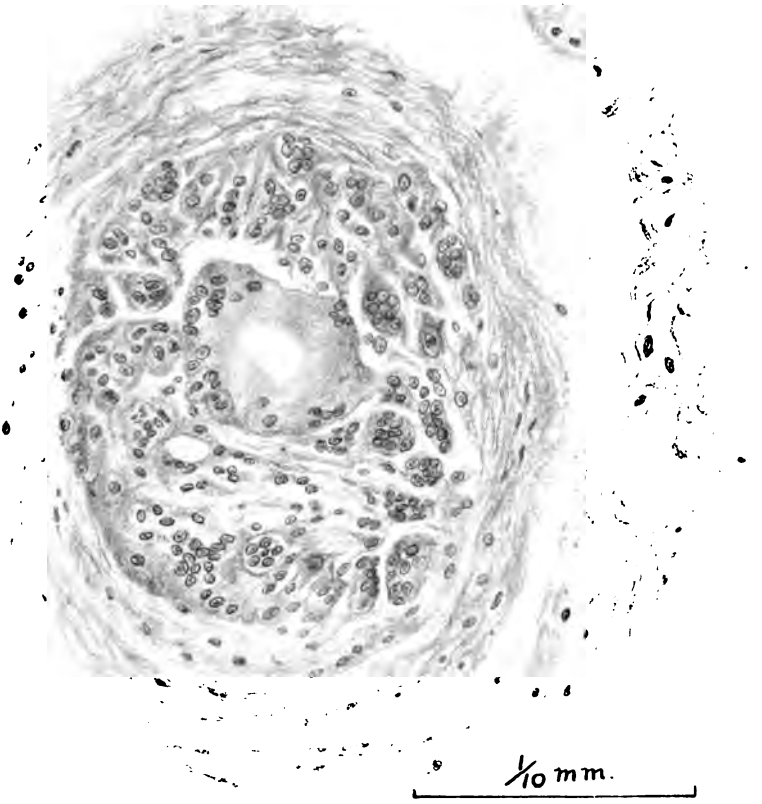
Examination revealed a swelling the size and form of a small butternut in the lower and inner part of the orbit, which gave the impression of a bunch of small angle-worms to the examining finger. Firm pressure elicited crepitation and caused the swelling to disappear. The mass appeared to have no connection with the adjacent bone below or with the lacrimo-ethmoidal cells internally, which presented nothing unusual in their external appearance. The eyeball was normal, nor was there evidence of any involvement of its external muscles. Although the mass was thought to be vascular, having arisen in consequence of the injury done to the tissues by the probing, the patient was subjected to a careful study of the orbit and of the adjacent sinuses by the *x*-ray, and by a rhinologic examination, the former by Dr. H. K. Pancoast, of the University Hospital, and the latter by Dr. George B. Wood, a colleague of the Howard Hospital staff. The reports received from both of these gentlemen were, however, negative.

Rejecting any attempt at extirpation of the growth by electrolysis or other subcutaneous method, the writer determined to expose the mass by free incision into the orbit, and the patient was accordingly admitted into the Howard Hospital, where she was placed under ether narcosis. With the aid and counsel of Dr. Wood, a free curvilinear incision was made over the inner and lower margins of the orbit, and the dissection rapidly carried through the skin and subcutaneous tissues to the mass. This was found to be almost the size of a large butternut, to be free from connection with the bone, but to be closely blended with the tissues in the region of the sac and those directly below the conjunctival fornix. The surface o the mass was studded with numerous small cyst-like elevations, which crackled under the finger. No distinct capsule could be defined. The dissection and removal of the mass from the surrounding tissue were accomplished without great difficulty and with but little hemorrhage. A careful exploration of the region of the sac revealed no trace of this structure, nor could any defect be found in the exposed walls of the orbit. The lips of the wound were coaptated by silk sutures and a pressure band-

age applied. Healing was prompt, the scarring slight, and there has been no return of the mass. About as much lacrimation is complained of as is present after the successful removal of a sac, but pressure can elicit no crepitation and there is no swelling.

The pathologic report by Dr. George B. Wood is as follows: "The tumor mass, measuring 3 by 1 by 1 cm., was soft, with numerous small empty cysts scattered irregularly through its substance. None of these were larger than a split-pea. The smaller cysts were semi-translucent and distinctly palpable; the larger ones were soft. There was no capsule or definite limit to the mass. The histologic examination shows a fibrotic stroma with occasional small collections of lymphocytes, and scattered through it numerous small cysts varying in size and without contents (Plate I). The walls of these cysts were made up of concentrically arranged fibrous tissue and lined with a thick layer of epithelioid cells, though in the larger cysts this layer was thinner and less well marked. Some of the smaller cysts were apparently occluded by these epithelioid cells and showed very little fibrosis. Numerous foreign body giant-cells were present, more commonly in the smaller cysts, though occasionally very large giant-cells, flattened out apparently by some form of pressure in the cyst cavity, could be observed in the walls of the large cysts (Plates II and III). At places the layer of epithelioid cells seemed distinct from the fibrotic tissue, and at other places the epithelioid cells merged into the surrounding fibroblasts. The walls of the blood-vessels were not altered, and there was no proliferation of their endothelium. The tissue was very vascular, but not of angiomatous character. There was considerable muscle tissue in the mass, probably a portion of the orbicularis palpebrarum. No evidence of glandular tissue could be seen nor could any accumulation of cells suggesting a neoplasm be found.

"It seems probable that this specimen is not a true tumor, but the reaction of tissue to some form of foreign body irritation. From the history of the case, the deduction is reasonable that at the time of the operation upon the nasolacrimal duct the walls of the lacrimal sac or part of the duct were torn and in some way air was forced into the tissues of the



Case I, Plate III.—High-power drawing of a small cyst obliterated by granulation tissue, with numerous giant-cells, some of them very large, also showing the concentric arrangement of the fibrous tissue composing the wall of the cyst.

lower lid. Subsequent inflations of this tissue due to blowing the nose, etc., kept this opening patulous, and either the pressure of the air in the tissues or the forcing in of lacrimal secretion and minute foreign bodies produced a reaction in the tissues with the formation of giant-cells. In the smaller cysts the process is apparently one of obliteration, but it is probable that as long as a communication with the nasal duct was kept up, pressure in the larger cysts would prevent their closure. The larger cysts apparently communicate with each other, though intercommunication of the smaller ones is not shown. As far as I can ascertain, the specimen is unique, though a somewhat similar condition was reported by Dr. Blatters several years ago to the New York Pathological Society. In this case of Dr. Blatter's there were distinct cyst-like spaces with giant-cell formation in the wall of the intestine."

Dr. Wood says that as far as he is aware the specimen is unique, and the writer, speaking from his own experience and after a fairly comprehensive review of the ophthalmic literature bearing upon orbital and lacrimal conditions, would substantiate this opinion. The entrance of air into the tissues of the orbit following fracture of one of its walls is a common condition, but the emphysematous condition soon disappears and no complications follow. Serous cysts may at times follow hemorrhages into the orbit resulting from degeneration of a blood-clot, and in very exceptional cases emphysema of the orbit has arisen in consequence of gangrenous decomposition of fluid which has escaped into the tissues after a penetrating wound. In the case under consideration, however, the pathologic findings were not that of a broken-down clot, and there is no history of a phlegmonous inflammation. The air doubtless entered the tissues in the region of the sac, through a small fissure or fissures in the inner orbital wall, in consequence of the false passages of the probes, and the neoplastic mass or air tumor, as it might be designated, arose, in all probability, as Dr.

Wood has surmised, by the reaction in the tissues neighboring upon the sac to some form of foreign body irritation.

CASE 2.—Large lacrimal mucocele occasioned by pressure exerted externally by the distended walls of the anterior ethmoidal cells, in consequence of the retention of mucus within that cavity.

In January, 1912, the writer was consulted by a young man with a large mucocele of the left lacrimal sac. There was but little of moment in the history, lacrimation having been complained of for some years past; at no time had there been any inflammatory reaction in the affected eye. The patient was colored and had the low broad nose and scaphoid face not unusual in his race. He had never suffered from nasal catarrh, and his health otherwise had been good.

Extirpation of the sac was easily and completely effected by Meller's method, and, save the slight lacrimation which is the rule after extirpation of the sac, the patient had nothing to complain of. About a year later, however, following an attack of influenza, the writer was again consulted on account of a swelling which had recently appeared in much the same position as that previously occupied by the sac. This was somewhat sensitive to pressure and would doubtless have been slightly reddened had the patient's color permitted this sign of inflammation to be manifested. Examination showed this swelling to be due in all probability to a distention of the anterior ethmoidal cells, for the walls of the sinus had been apparently pushed forward, and palpation gave the impression of fluid beneath the tense periosteum, the bony framework of the sinus having evidently been eroded away by long-continued pressure from dammed-up secretion within.

The patient was accordingly etherized, and, with the assistance of Dr. Wood, the writer made a careful curvilinear incision over the tumor, the line of the incision following the outlines of the lower inner margin of the orbit. A deeper incision opened the mucous sac, which immediately came into view, and a large mass of mucoid material, partially tinged with blood, oozed out of the wound. The diagnosis of mucocele of the ethmoidal cells being confirmed, a free opening was established by the use of bone gouges and

chisels into the roof of the nose, and drainage obtained by the passage of a good-sized drainage-tube from the sinus into the nose. No dead bone was encountered and there was no evidence of involvement of any of the cells of neighboring sinuses. The incision into the orbital tissues was then carefully closed and a firm pressure bandage applied. Healing was rapid and uneventful. The sinus was syringed daily through the nasal end of the tube for some weeks. At the end of a month the tube was removed, though the patient reported to Dr. Wood at frequent intervals for some time longer, to insure the patulency of the orifice from the sinus into the nose. Five months have now elapsed since the operation and there is apparently no obstruction to the flow of the mucus into the nose; the scar of incision is barely perceptible.

The writer is of the opinion that the sequence of the double mucoceles in this case may be explained as follows: The patient, already predisposed by the anatomic formation of his skull to retention of the mucous secretion from the ethmoid cells by presumably too small avenues of exit, had doubtless had these completely closed from some catarrhal condition of his nose. In consequence of this obstruction to the orifice the mucus within the cells had slowly distended its lateral wall, thereby exciting gradual and continued pressure upon the lacrimal sac, displacing this structure from its position in the lacrimal groove and hindering the escape of its contents into the nose by a compression of the lacrimonasal duct and perhaps closing the canaliculi by a similar process. The lacrimal mucocele was extremely large, and none of its contents could be expressed either through the canaliculi or into the nose.

The writer has already called attention* to this secondary closure of the sac from pressure exerted externally by the walls of the ethmoidal cells, and referred to Peters' paper,†

* Trans., Sect. on Ophth., A. M. A., 1905.

† *Zeitsch. f. Augenh.*, 1899, p. 154.

in which that author stated that in his opinion many cases of ectasia of the lacrimal sac were to be regarded as nothing more than a manifestation of disease of the accessory sinuses of the nose.

DISCUSSION.

DR. EDWARD JACKSON, Denver: It occurred to me that possibly the implantation of epithelium in lacerated tissues might account for these cysts. Perhaps it is necessary to suppose some additional irritant in connection with the giant-cells, but the implantation of epithelium might be a factor.

REPORT OF A CASE OF CAVERNOUS SINUS THROMBOSIS RESULTING FROM A SMALL ABSCESS IN THE SKIN OF THE TEMPLE. VACCINE TREATMENT.

ALBERT C. SNELL, M.D.,
Rochester, N. Y.

This patient, Peter Theordorakas, first consulted me June 4, 1911. He was a native of Greece, aged twenty-four years, and employed as a candy salesman. He had an unusually fine muscular development, being nearly six feet tall and weighing about two hundred pounds. He had always enjoyed perfect health.

During the twenty-four hours previous to the first visit he had noticed that vision in the right eye was growing bad rapidly, and was accompanied by rapidly swelling lids. There was no trauma and there was absent history of any general disease or infection.

Inspection revealed very marked swelling of the lids, which were inflamed and edematous. After elevating the upper lid, we found edema of the conjunctiva, a pronounced exophthalmos, and nearly complete limitation of ocular movements, a steamy cornea, and a pupil which reacted sluggishly to light. The ophthalmoscope showed swelling

and edema about the optic disc, and enlarged, tortuous veins. His pulse was rapid and temperature was 100° F. In the skin of the temple, on a line parallel with the eyebrow, I observed a small area, not more than 2 or 3 mm. in diameter, which had swollen, granulated edges, and was covered with a crust from under which a small amount of pus was obtained by pressure. On questioning him in regard to this abrasion of the temple, he stated that there had been a small "pimple" which he had pinched with his fingers a few days previous. The relationship of this small abscess to the ocular condition was not fully recognized by me at this time, but I was unable to find any other possible etiologic factor. The diagnosis of orbital cellulitis was made, and the patient was sent to the general hospital.

Treatment for the first three days was palliative, consisting of iced bichlorid compresses continuously day and night, cathartics, and rest in bed. During this time the lids had become more swollen and board-like, pain became more severe, and temperature and pulse-rate gradually rose. There were no signs of pointing and no fluctuation either in the lid or in the orbit.

On the evening of the fourth day a small ulcer made its appearance in the lower quadrant of the cornea and there was present also a small hypopyon. Temperature in the evening reached 104° F., pulse 102. The significance of the small abrasion in the temple now occurred to me as the real cause of the orbital cellulitis, although it was still small, 2 or 3 mm. in diameter, and appeared merely as a flat crust. But from under it some pus was obtained, and the edges had become slightly swollen and red. I therefore decided to explore this region. The crust was removed and more pus was found and the skin was seen to be undermined. The wound was slightly enlarged and a probe was easily passed downward and inward toward the outer bony margin of the orbital brim. A counter-puncture through the skin was made here at the lowest point, and the sinuses washed out with bichlorid solution. There was no evidence of any pointing in the neighborhood of the orbit, but I determined on puncturing the orbital cavity. After cleaning as carefully as possible this was done at two points with a sterile long-bladed knife. The first puncture was made down and

in between the internal rectus and inferior rectus muscles; and the other, up and in just above the internal rectus muscle—in both cases going through the skin and lids, and carrying the point of the knife two and one-half inches deep. These punctures bled freely but no pus was found. Hot bichlorid compresses were applied fifteen minutes each hour. Temperature was much lower the following morning and patient seemed better.

The next day, the fifth after entering the hospital, the temperature was still lower. On this day there appeared a very decided swelling of the left jaw, and patient complained of soreness and stiffness in the back of his neck.

On the evening of the sixth day temperature again went up, reaching 104.3° F., and pulse-rate was 115. Fluctuation was now found in the upper lid. An incision was made into this and several drams of pus were evacuated. The skin in the entire upper lid seemed to be undermined, a probe passing freely under it everywhere. The sinuses of the temple and the lid were flushed with bichlorid and peroxid. Following the opening and cleaning of the abscess in the lid the temperature dropped to 102° F., the lowest it had been since the third day.

Although the patient continued to show improvement in temperature and pulse, on the evening of the seventh day he became delirious, gradually sinking into a stupor, and the next evening temperature reached 104⅗° F. It seemed apparent that there was present a severe general infection. After consulting with an internist it was thought best to give him immediately a stock preparation of antistreptococcic serum. Twenty c.c. was given at 1.30 and at 8.30 P.M., twenty c.c. again the following afternoon at 6.30, and again at 12.30 A.M.

The following day after the last injection there appeared a slight eruption on the skin of his body. The general condition remained unchanged for twenty-four hours; but at the end of this period, the eleventh day, patient regained consciousness, temperature dropped to 101⅗° F., pulse-rate to 90, and patient was very much better in every way, taking his nourishment, and regaining control of his urine which, during his delirium, had been passed involuntarily. There was a daily improvement for the following ten days. Tem-

perature dropped to 99° F., pulse-rate to 72, respiration to 20. He was so nearly normal that it seemed certain that he would get well. The discharge from the sinuses of the lid and temple had nearly ceased, but sinuses were carefully dressed and flushed each day. At no time was pus found in the orbit. Swelling and edema of the lids had subsided, but cornea was very steamy. The ulcer had spread, hypopyon being still present, iris bound down, exophthalmos and limitation of motion continuing.

On the afternoon of the twenty-first day the pulse suddenly went very bad and became very rapid. Strychnin, digitalis, and supporting measures were administered. Patient now became profoundly unconscious. Two doses of antistreptococcic serum were again administered, but patient rapidly grew worse, temperature running up to 107° F., pulse-rate to 170, respiration to 70, when he died, on the morning of the twenty-third day after his admission to the hospital.

There are two factors of special interest in this case. The first is that a fatal termination should result from so trivial a wound. His own statement was that he "pinched a pimple" in the skin in the region of the temple. In this way he undoubtedly infected the small wound with his finger. I had observed that his finger-nails were unusually long and dirty, and this was possibly the real source of the infection. A case with a more trivial beginning than this was reported by Simeon Snell*—a case of fatal thrombosis following the prick of a pin in the upper lid.

Infections of the face are second to sinus diseases in the causation of cavernous thrombosis. Jackson,† adding 28 cases to the 182 compiled by DeWight and Germain, showed that in this total of 210 cases the source of the infection was in the region of the face in 39 cases, showing that approximately 20 per cent. of all cases of cavernous sinus thrombosis are due to primary infection of the face.

* *Trans. Ophth. Soc. United Kingdom*, v. xxxvi.
† *Ophthalmology*, 1909, vol. v, p. 185.

The second point of interest in my case is the very probable effect of the streptococcic serum. After the use of this the mental symptoms cleared entirely, and at the same time came the very marked improvement in temperature, in pulse, and in respiration, which lasted for nine days. One case, of course, does not prove anything, but the use of streptococcic serum in this case is suggestive of possible good results from this treatment. If there had been time to obtain an autogenous vaccine, it would have been the preferable one to use.

I am sorry to state that no attempt was made to determine the specific bacteria, and also that an autopsy was not permitted. I have been unable to find in the literature that vaccines have ever been used in any case of cavernous sinus thrombosis; and in view of the fact of the very high mortality in these cases, a suggestion as to any possible rational aid in the treatment should be welcome.

DISCUSSION.

DR. EMIL GRUENING, New York: Infective thrombosis of the sinuses of the brain frequently occur in otologic practice, but the otologists do not use serum. They remove the clot from the lateral sinus and often succeed in saving the patient. At the meeting of the International Otological Congress in Boston last year, Mr. Ballance, of London, read a paper on the operation of removing clots from the cavernous sinus. I think it would be of the greatest importance for ophthalmologists to study the matter of reaching the cavernous sinus and getting directly at the thrombus. Mr. Ballance has suggested two methods in which this may be done. Inasmuch as the cases of infective thrombosis of the cavernous sinus generally end fatally, the way of reaching the sinus and removing the thrombus should be eagerly sought.

DR. EDWARD JACKSON, Denver: In two recent cases in which I have seen autopsy of cavernous sinus thrombosis, the thrombus did not fill the cavernous sinus. It did seem

to fill one of the orbital veins and extend into the cavernous sinus, but by no means to fill it. In one of the cases I think the gentleman who was making the autopsy was inclined to say there was no clot there, but in looking a little more closely there was found a long tail of not very recent clot extending into the sinus from one of the orbital veins. I have seen one case in which there was apparent recovery. It was a child in whom the cavernous sinus was involved, following disease of the mastoid and of other venous sinuses. The swelling of the face entirely disappeared. The child seemed to be quite well, and continued so for about four months. Then she suddenly died with cerebral symptoms, and we found an abscess in the temporal lobe. One point in the diagnosis which has not been raised here, but I think it is of value because it gave me the diagnosis this last winter in an obscure case, is the crossing of the lesion. As I remember it, the original point of infection was in the alveolus on the left side. It was the right orbit that became swollen.

DR. E. E. JACK, Boston: With reference to Dr. Gruening's remarks, I suppose one of the difficulties in operative procedure is in making the diagnosis soon enough. In the cases I have seen, the distinctive points in diagnosis (extreme tortuosity of the retinal vessels and edema of the mastoid) have been wanting, and it was impossible to make the diagnosis in time to make operation successful.

DR. JOHN E. WEEKS, New York: I would call attention to a case reported by Dr. H. Knapp, of orbital sarcoma following traumatism. A thrombosis of the cavernous sinus developed, which was diagnosed by Dr. Knapp, and operated on by Dr. Frank Hartley, of New York. The sinus was reached, and the clot was found on one side and the bleeding from the opposite side was established. The patient lived some time after operation. Will Dr. Snell kindly tell us the nature of the infection in his case?

DR. F. H. VERHOEFF, Boston: A year ago I performed an autopsy in a case similar to that of Dr. Snell. It was that of a man who had a small furuncle within his nose. The infection extended up on the outside of his nose, along the subcutaneous tissue, into the orbit, and in three or four days he was dead. At autopsy he showed orbital cellulitis,

thrombosis of the cavernous sinus, and meningitis. I thought the meningitis was due to extension from the orbit through the anterior lacerated foramen. The infecting organism here was the very common staphylococcus aureus.

DR. ROBERT SATTLER, Cincinnati: I want only to add another to the unfortunate list of fatal cases. The patient was a dentist. His physician attributed the orbital lesion to a small furuncle on the left ala of the nose which the patient thought had been caused by infectious material from the mouth of a patient with pyorrhœa alveolaris. He had large abscess cavities in both orbits which were opened and drained. The most careful bacteriologic examinations were made by experts. Smears and cultures disclosed only staphylococcus pyogenes aureus and citreus. After a lingering general pyemia he died.

DR. ALBERT C. SNELL, Rochester, N. Y.: Dr. Ellett read a paper before the Section on Ophthalmology, of the American Medical Association, urging that operation be done in these cases, since there was nothing to lose, all his cases being fatal. I think the difficulty in operating for thrombosis is in making the diagnosis. As soon as this man had thrombosis he was dead. In answer to Dr. Weeks' question, I feel like apologizing, because I did not make a bacteriologic examination and an autopsy was refused.

SARCOMA OF THE CHOROID NOT DEMONSTRABLE BY THE ORDINARY TRANSILLUMINATOR.

ALLEN GREENWOOD, M.D.,
Boston.

A busy ophthalmic surgeon will see on an average of one case of choroidal sarcoma every year or two, so that such cases are not of sufficient rarity to perhaps warrant the reporting of a single case unless it presents points of especial interest.

We are aware that post-equatorial choroidal sarcomas are not readily demonstrated by the use of the ordinary transilluminator, and if situated far back, are not at all so, and often in such cases the diaphanoscope may show nothing. If, however, the transilluminator tip could be placed at the back of the eye, such tumors would be easily demonstrated, and one object in my reporting this case was to call attention to the value of the modified transilluminator devised and shown at this meeting by my confrère, Dr. Walter B. Lancaster.

This instrument consists of a 7 cm. metal tube, about the size of a No. 9 Theobald probe, and bent somewhat to conform to the curve of the eyeball. In an opening on the concave surface near the tip there is a tiny but powerful electric lamp, and the whole can be attached to the socket of a small pocket battery.

Mrs. W. R., aged thirty-one, with family and previous history as to eyes negative, came to me December 27, 1912, giving the following history of her present trouble:

About three months ago she noticed that the vision of the right eye was slightly blurred, and, as this showed a tendency to increase, she consulted an optometrist and was given glasses, but with no help, so that she soon discarded them. Three weeks prior to her visit to me the eye had suddenly become very red, painful, and the blur very much greater. Her physician, thinking he had a case of iritis, ordered atropin, but the inflammation steadily increased and the eye became practically blind.

Examination showed the right eye in the stony, hard condition of absolute glaucoma, with the cornea so steamy and the media so cloudy that only a faint reflex could be obtained with the ophthalmoscope. There was only the faintest perception of light and no accurate projection. The Würdemann transilluminator showed evenly a dull red reflex everywhere, even when pushed as far back as possible. The other eye showed no abnormality and no suggestions of glaucoma.

The age of the patient and the absoluteness of the glaucoma, combined with the lack of signs in the other eye, inclined me to suspect intraocular tumor, but I could get no history from the patient pointing to loss of any particular part of the visual field, and, nothing being shown by the transilluminator, it was decided to treat the case as one of acute glaucoma, so when eserin and pilocarpin failed to afford relief, an iridectomy was performed, with immediate cessation of the pain but no restoration of vision. The lack of good results from eserin, and there being no restoration of vision following the operation, would lead one to suspect that the glaucoma was due to an intraocular growth, or, in an older person, to thrombosis of the retinal veins.

A week later the cornea and media had entirely cleared up, so that a good ophthalmoscopic examination could be made, and then it was seen that there was a retinal detachment covering the optic disc and extending downward and forward. Transillumination again showed nothing, but

the eye was removed, as the diagnosis of intraocular tumor seemed certain. On testing the enucleated globe with the transilluminator, and pressing the point of the latter to the back of the eye, close up to the exit of the nerve, an entire loss of light transmission could be observed, which was immediately brought back if the transilluminator was moved more than 4 mm. from any side of the nerve.

The accompanying drawing shows the location and size of this intraocular tumor, and I am indebted to my con-

Location and size of intraocular tumor.

frère, Dr. F. H. Verhoeff, for the following pathologic description of the growth:

The specimen submitted for examination consists of the posterior half of an eye. Attached to the posterior wall, and completely covering over the optic disc, there is a globular tumor with constricted neck which measures 1 cm. in greatest diameter. Its cut surface is irregularly but highly pigmented. Microscopic examination shows the tumor to be a melanotic spindle-cell sarcoma presenting no especially unusual features. There are a number of areas of necrosis, some of them old, from one of which a small

hemorrhage has taken place. The choroid is invaded for a considerable distance from the main tumor. The sclera has not been perforated. The optic disc has been completely destroyed by the tumor, but the nerve-stem shows no invasion. The retina evidently remained adherent to the tumor, but is now almost completely destroyed over the surface of the latter. Pathologic diagnosis: Melanotic spindle-cell sarcoma of choroid.

The majority of choroidal sarcomas are seen either in the first stage, when they give the appearance of a rounded subretinal mass, or in the second stage of retinal separation, and in either of these the ophthalmoscope is usually sufficient for a diagnosis, with the use of the transilluminator as a confirmatory test, but in any case occurring in a young woman about the age of my patient, seen first in the glaucomatous stage, where the ophthalmoscope is of no assistance and the ordinary transilluminator shows no evidences of an intraocular growth, such an instrument as that devised by Dr. W. B. Lancaster might save the necessity of two ether operations.

DISCUSSION.

DR. EMIL GRUENING, New York: At the last meeting of the New York Ophthalmological Society Dr. Reese showed a case that is exactly like the one of Dr. Greenwood. He presented the eyeball; it was entirely filled with a leukosarcomatous mass, which, however, was separated from the sclera by a space containing a transparent fluid. In the enucleated eye a shadow could be obtained by pressing the sclera against the tumor.

DR. PERCY FRIDENBERG, New York: It seems, from what Dr. Greenwood tells us of the result of transilluminating the globe after enucleation, that there would have been some difficulty in obtaining a shadow, even with the instrument shown, which to me appears a valuable improvement. The light source would, at all events, have had to be directed forward, *i. e.*, toward the pupil, from a point within a radius

of 4 mm. of the disc. Some years ago I devised a modification of the Würdemann instrument, designed to throw light from a point further back toward the equator than was practicable with the straight tip. The latter can only be carried about as far as the equator, and then throws rays away from and not toward the observer. The modified tip which I showed at the St. Louis meeting of the American Medical Association, and also before the New York Ophthalmological Society, consisted of a glass rod bent back toward the handle at a sharp angle, forming a sort of hook. When applied to the globe, the light-rays "come back" at the observer almost parallel with the handle, and give a shadow of a mass well back of the equator. The modified tip is made by Hardy and Company. I think the instrument presented by Dr. Greenwood will be of great service in doubtful cases, where the probability of a new-growth would fully justify the incision into the conjunctiva necessary to carry the transilluminator back along the globe.

DR. W. B. MARPLE, New York: I would like to ask Dr. Greenwood whether he employed the Hertzell diaphanoscope in his case? I have been trying it for two years, but, unfortunately, in my cases the ordinary transilluminator has been successful. It seems to me that if any form of transilluminator would facilitate the diagnosis in these cases it would be the Hertzell instrument.

DR. R. L. RANDOLPH, Baltimore: I want to refer to two cases somewhat similar to those reported by Dr. Greenwood. It was impossible to get a view of the fundus in either case, and an iridectomy was performed to relieve very high tension. While the possibility of an intraocular growth was kept in mind, the evidences of such a condition were not strong enough to warrant immediate enucleation. It was in the pretransilluminator days. There was not the slightest improvement in the condition of the media following the iridectomy; on the contrary, within three days a pinkish mass was extruding from the corneal wound in both cases, thus establishing the diagnosis of an intraocular neoplasm. I cannot help thinking that iridectomy adds to the danger of infection in such cases by opening up blood-channels and stimulating the advance of the growth in this region. Per-

sonally, I am in favor of enucleating eyes at once which present such a picture rather than temporizing with them in the hope that we are dealing with nothing more than a question of high tension based perhaps on intraocular hemorrhages.

DR. ALLEN GREENWOOD, Boston: In regard to what Dr. Fridenberg said, I ought to have called attention to the fact that when the transilluminator was moved more than 4 mm. from the optic nerve of the enucleated eye I got a slight transmission, but not so bright as after further removal. Close to the optic nerve it gave absolute blackness to the pupillary area.

EPIBULBAR CARCINOMA; HISTOLOGIC EXAMINATION OF THE SPECIMEN.

G. E. DE SCHWEINITZ, M.D., AND E. A. SHUMWAY, M.D.,
Philadelphia.

Although the subject of epibulbar carcinoma has occupied the attention of ophthalmic pathologists and clinicians, and elaborate studies of this type of neoplasm are on record, it may not be out of place to describe the history and microscopic examination of the present specimen.

History.—A man, aged thirty-four, came to the University Hospital on November 4, 1912, for the examination and relief of an epibulbar growth of the left eye. In childhood the patient had measles, chicken-pox, and whooping-cough, and in later years pneumonia, malaria, and typhoid fever. He admits Neisserian infection, and also that at the age of twenty-three years he acquired a lesion which probably was the initial lesion of syphilis. Born in California, the patient has lived in various parts of this country and for the last three years in Philadelphia. His occupation is that of a packer in a vacuum-cleaning establishment. He is married, has one child living and well; his wife has had four miscarriages. His habits are good; he smokes moderately and occasionally

drinks beer, but not to excess. The patient's father died of unknown cause; his mother is living and well; two brothers are alive and in good health. There is no history of tuberculosis or neoplasm in the immediate family or among relatives with whom he is acquainted.

History of the Present Condition.—In 1898 the patient noted a small, yellowish-white, papular growth the size of a split pea at the inner corneal margin of the left eye. The surrounding blood-vessels were injected, but there was neither pain nor disturbance of vision. This growth remained stationary for about three years. Eleven years ago he applied at the dispensary of the Pennsylvania Hospital for treatment, and there the lesion was cauterized with the actual cautery. Following this cauterization he reports rapid enlargement of the growth, so that it soon covered one-third of the pupil space. For a period of four years the neoplasm remained quiet and did not grow in size, when following what he calls cold in the eye the growth began to increase in size, and by the year 1907 had covered the whole front of the eye to such an extent that it protruded between the lids and in appearance reminded him of a large strawberry. One year ago this protruding mass underwent a species of softening and liquefaction, and soon developed the appearances which were present at the time of examination.

Physical Examination.—The patient has neither cough nor night-sweats, the appetite is good, the bowels are regular and their palpation reveals no abdominal growth of any description. Examination of the urine was practically negative, with the exception of a few oxalate of lime crystals. The blood count was as follows: Red blood-corpuscles, 5,220,000; white blood-corpuscles, 6,300; hemoglobin, 90. There was no eosinophilia; polymorphonuclear leukocytes, 91, leukocytes, 8. Careful examination of the nasopharynx and accessory sinuses failed to reveal anything except a slight nasal catarrh. The Wassermann test was positive; von Pirquet's test was negative.

The vision of the right eye was normal, and it showed no abnormalities of any character. The entire front of the left eye, the vision of which was faint light perception, was covered with a thick, grayish-yellow or, more accurately, reddish-yellow mass, very closely resembling granulation tissue, the

center of which was somewhat umbilicated and contained some sloughing detritus. The eyeball movements were normal and palpation failed to reveal any growth in the deeper portion of the orbit.

The eyeball was enucleated on November 12, 1912, and exploration of the orbit after enucleation failed to reveal the presence of any suspicious tissue. In due course an artificial eye was adjusted, but at the expiration of three months the patient returned with the tissues of the orbit much swollen, and in the upper and inner portion of the cavity an indurated mass was visible, evidently representing a recurrence of the growth. Therefore a complete exenteration of the orbit was performed, healing was entirely kind, and up to the present time, four months after the operation, there has been no sign of recurrence.

Macroscopic Examination.—The anterior segment of the eyeball is covered by a tumor mass, which measures 27 mm. across, and extends backward along the outer surface of the sclera a distance of 6 mm. on the temporal and 4 mm. on the nasal side. The growth appears to consist of two lateral masses, one on either side of the former site of the cornea; the portion on the nasal side has a thickness above the sclera of 8 mm., that on the temporal side of 5 mm. Between them is a depression where the cornea has been replaced by a faintly staining tissue, which measures 2 mm. in thickness. The lens is displaced forward and to the temporal side, pulling the ciliary body away from its scleral attachment. The retina is totally detached (Fig. 1).

Microscopic Examination.—The tumor surface is covered by a layer of flattened epithelial cells, which have undergone horny change, their nuclei no longer staining with the hematoxylin. The tumor substance is composed of broad processes of cells in direct connection with, and extending backward from, the surface epithelial cells, the stroma being a dense connective tissue which has developed from the sclera and episcleral tissues.

The cell masses extend in various directions, some of the processes being cut longitudinally, some transversely, and some obliquely. The outermost cells of the columns stain deeply and are columnar in shape; toward the center, well-marked changes in the cells are in evidence, due to nuclear

Fig. 1.—Section of eyeball showing position of epibulbar growth.

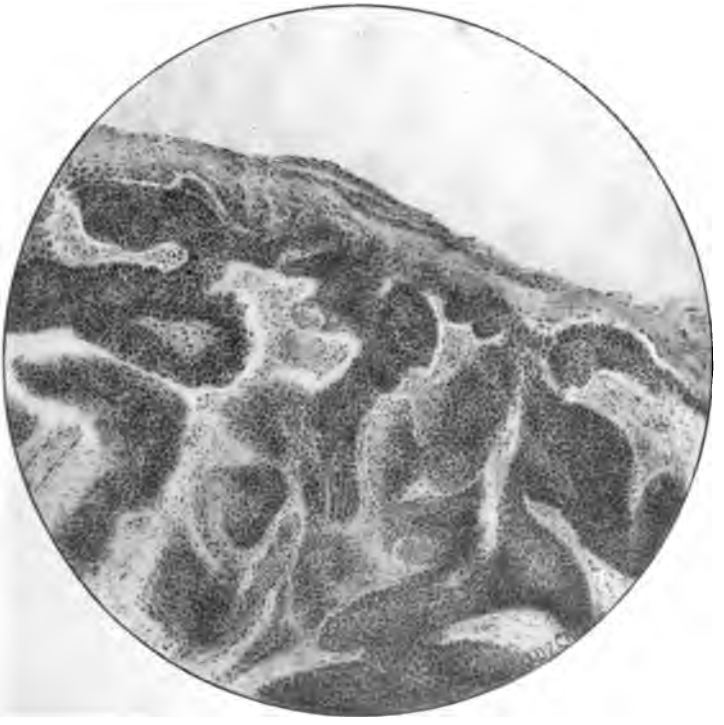


Fig. 2.—Primary epibulbar carcinoma; microscopic appearances.

The crystalline lens is pushed forward, especially on the temporal side, where the anterior chamber is abolished, and the iris here is in contact with the posterior surface of the cornea. The lens shows no pathologic changes. On the nasal side the ciliary body has been torn away from the sclera by the displacement of the lens, the iris and ciliary body on this side being adherent to the lens capsule in front of and behind the equator. The retina is detached and passes forward to the posterior pole of the lens.

The iris shows a chronic iritis, indicated by its infiltration with mononuclear round cells, especially along the vessels; the stroma and the sphincter muscle are atrophic. The ciliary muscles are also atrophic; the vessels of the ciliary processes and choroid are hyperemic. The retina is entirely atrophic, being converted into a dense connective-tissue cord, from which all nervous elements have disappeared, and is irregularly infiltrated with pigment from the retinal pigment cells, particularly along the thickened blood-vessel walls. The optic nerve is atrophic, the nerve-bundles being reduced in diameter, and the septa considerably increased in thickness.

The recurrence in the orbit consists of a nodule 9 mm. in diameter, composed of orbital tissue, which has been partly destroyed by columns of epithelial cells running in various directions. The cells resemble those of the deeper cells of the surface epithelium of the conjunctiva. There are many mitotic figures, a moderate amount of karyorrhexis of the nuclei of the cells, in the center of the infiltrating processes, and round-cell infiltration of the orbital tissue in advance of the growth. Epithelial pearls are absent, but prickle cells can be made out.

The pathologic examination has, therefore, confirmed the clinical diagnosis of *primary carcinoma of the conjunctiva*, beginning at the limbus. It may possibly have started as a papilloma, and, as the result of cauterization, may have been stimulated to rapid growth and then assumed a malignant type.

Primary carcinoma of the bulbar conjunctiva cannot be said to be of common occurrence, although a good many

cases are now on record. In 1908 Rschanitzin searched the literature in Michel's Jahresbericht, and found 502 cases of conjunctival tumors. His classification includes 250 benign and 252 malignant growths. Of the malignant forms, 149 were carcinomas and 103 were sarcomas. Primary carcinoma of the bulbar conjunctiva is less frequent than carcinoma of the eyelid secondarily involving the eyeball. The literature of the subject up to the year 1904 may be found in Saemisch's article on "Diseases of the Conjunctiva," in the second edition of the Graefe-Saemisch Handbuch der Gesamten Augenheilkunde,* and from 1904 to 1910 in an article by Heilbrun, in Graefe's Archiv f. Ophthalmologie,† An examination of the Jahresbericht and the Index Medicus has revealed a few more reports, reference to which will be found at the end of this paper.

Of practical importance in connection with these growths from a clinical standpoint is invasion of the eyeball. Some authors, for example, Axenfeld, Greeff, Wintersteiner, and Saemisch, consider that they rarely penetrate the globe, while Ginsburg and Parsons express an opposite opinion. Ischreyt in 1906 reviewed the subject carefully, and tabulated 47 cases from the literature. He assumed that there was perforation where the invading cells had reached the inner surface of the sclera or the region of Schlemm's canal, even where the anterior chamber was not involved. In 17 of the 47 cases perforation had actually occurred, a percentage of 36.1. In the literature since 1906 we have been able to find the reports of six additional cases of epibulbar carcinoma, and in three of them perforation of the globe was demonstrated. In 53 eyeballs, therefore, perforation occurred in 20, or 37.6 per cent. Hence, although the cornea and sclera offer a considerable resistance to the growth of the tumor, especially if Bowman's membrane be intact, it is evident that perforation occurs in a considerable number

* Volume v, p. 677. † Bd. lxxvii, 1910, p. 541.

of cases, especially if the neoplasm has been present for a long period of time. Naturally, this percentage is relatively too high, because the eyes examined were those in which the lesion has assumed serious proportions demanding enucleation.

Frequency of perforation depends largely upon the site of the tumor. It has been found that those growths which are situated at the corneal limbus are much more apt to penetrate the globe than those placed at a distance from it, and, as is well known, the region of the penetrating ciliary vessels presents a feeble resistance to a growing carcinoma, because its cells invade the tissue along the perivascular lymph-sheaths. This fact is of great importance in determining the proper surgical procedure in any given case. Should the carcinoma be situated at the limbus, and should it be of very small size, deep excision may be practised, but only if the patient can be kept under prolonged observation. Growths at a distance from the limbus may be excised, with less danger of recurrence. It is true, however, that in the majority of cases the tumor is situated at the limbus. The epithelium changes in character in passing from the conjunctiva to the cornea, and, moreover, has a tendency here to send in irregular processes, as was shown particularly by Nakajawa. In this position, too, the growths are liable to injuries, often of a trifling character, but many times repeated. According to Lagrange, implication of the lymphatic glands in the neighborhood is rare, but occasionally occurs. Parsons says that the preauricular glands are first affected, and the submaxillary glands later. The existence of such a glandular involvement would be an absolute indication for enucleation, which, indeed, must be performed in the great majority of cases.

Another point of interest in connection with our case is the age of the patient. As a rule, this form of carcinoma is most frequently found in individuals over forty years of

age. In 7 patients with epibulbar carcinoma collected by Rogman the ages respectively were twenty months, twelve years, thirteen years, nineteen years, twenty-seven years, thirty-five to forty years, and thirty-seven years. The case histories of other patients have since been reported by Hartmann (twenty-nine years), Bianchi (twenty-eight years), and Heilbrun (twenty years). As the growth first appeared in the present instance fifteen years before the operation, it must have originated when the patient was nineteen years of age.

ADDITIONAL LITERATURE SINCE 1909.

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WOLFRUM: "Von beginnendem Karzinom der Conjunctiva bulbi," Berichte über die Versammlungen der ophthalmologischen Gesellschaft, Rostock, 1911, vol. xxxvii, p. 393.

DANIS: "Epithélioma du limbe sclérocornéen," La Clinique, Brussels, 1911, vol. xxv, pp. 614–616.

DISCUSSION.

DR. EMIL GRUENING, New York: In looking back on my own experience of epibulbar growth, I find that the removal of the growth does not prevent a local recurrence. I have several times performed the operation, limiting myself to the removal of the growth, but in no case of sarcoma or carcinoma did I succeed in extirpating the growth so thoroughly that it did not recur locally. Even after removing the eyeball, I first observed a recurrence in the orbit, and, in some cases that I could follow, metastasis in the liver and death.

DR. G. E. DE SCHWEINITZ, Philadelphia: I agree with

Dr. Gruening that in most instances it is proper to enucleate the eyeball, and yet I have removed an epibulbar growth—a sarcoma—from a patient's eye, and many years elapsed without a recurrence. Each patient presents a separate problem, and a perfectly definite rule cannot be formulated, although usually the indications for operation are those which Dr. Gruening has stated.

TOXIC AMBLYOPIA DUE TO TOBACCO ALONE.

MATTHIAS LANCKTON FOSTER, M.D.,
New Rochelle, N. Y.

In presenting this case to you, I wish to call attention to the etiology and to the unusually good result obtained by prolonged treatment.

A. B., aged sixty-five years, consulted me on August 2, 1911, because of a blurring of vision that had persisted for eight or ten months. He had been an inveterate smoker for many years, and was seldom without a pipe in his mouth for any great length of time. He stated that he had occasionally drank a glass of beer when a young man, but that he had drank no intoxicating liquors of any kind for over forty years, and that he did not indulge in patent medicines. He gave no history and presented no symptoms of syphilis, multiple sclerosis, or of any other organic disease of the central nervous system, aside from the trouble in his optic nerves, and the fact that he frequently felt dizzy after smoking. He had worn + 1.75 D. sph. for distance quite a number of years; with this glass the vision of his right eye was $\frac{20}{20}$, that of his left, $\frac{20}{200}$; without it the central vision of each eye was reduced to counting fingers at 4 feet. A central scotoma for red was present. The temporal side of the head of each of the optic nerves was so very white that I did not hesitate to record it in my notes as atrophy of the papillomacular bundle of nerve-fibers.

The most essential part of the treatment was the immediate and total abstention from tobacco in any form. In addition to this, strychnin nitrate was injected subcutaneously, beginning with a small dose, which was increased daily until physiologic symptoms were obtained. The amount required to induce these symptoms in this patient was $\frac{1}{8}$ grain. From that time on $\frac{1}{8}$ grain was injected subcutaneously twice a week for eleven months, the patient taking at the same time $\frac{1}{16}$ grain of strychnin sulphate by mouth three times a day.

The vision of his worse eye—the left—improved within two weeks to $\frac{20}{50}$ with the glass he was wearing. After that the improvement was slow but constant. At the end of six months the vision of his left eye was $\frac{20}{20}$ with +1 D. sph. ⊂+1 D. cyl. axis 180; that of his right eye was even better. At the end of one year V.=$\frac{20}{10}$ in each eye with the correction R. E. +1 D. sph. ⊂+.75 D. cyl. axis 180; L. E. +1 D. sph. ⊂+1 D. cyl. axis 180. At this time the appearance of the fundus was normal, and no affection of the papillomacular bundle could be seen. On March 3, 1913, eight months after the discontinuance of treatment, the vision of the right eye was $\frac{20}{15}$; that of the left, $\frac{20}{15}$, with the correction given above, but objects seemed a little "fuzzy" when seen with the left eye, in comparison with their appearance to the right. No central color scotoma could be detected in the right eye, but a minute central scotoma for red was present in the left.

Adam says, in his "Ophthalmologische Diagnostik," published in 1912, that it is doubtful if tobacco *alone* is competent to induce disease of the papillomacular bundle of optic nerve-fibers. "Ob Nicotin *allein* eine derartige Einwirkung haben kann ist zweifelhaft." This statement voices a feeling that is, I think, rather wide-spread, and is by no means inexplicable. Most men drink alcoholic beverages more or less; relatively few are total abstainers, and it is probable that the proportion of the latter is still smaller among men who use tobacco. It is generally admitted that the habitual use, or rather abuse, of alcohol

and tobacco together is able to excite a disease of the papillo-macular bundle of fibers in the optic nerve; that the proportionate quantities of the two necessary to induce this disease varies a great deal in individuals, and that total abstention from both is needed for a cure. We also know that habitual drinkers are not always perfectly truthful, so that when we see a patient with toxic amblyopia who admits that he uses tobacco to excess, but denies that he drinks, we question at once whether he is telling the truth about the latter. In the majority of cases we are unable to answer this question. On one occasion I sent a patient whose word I doubted to a physician to have his stomach examined, and received a report which seemed to indicate clearly an alcoholic gastritis, but we cannot always have recourse to such an expedient. If we wish to investigate, we have usually the difficult task of proving a negative. Absolute, incontrovertible proof that a man does not drink any form of alcoholic beverage can hardly be obtained, for this would require incontestable evidence covering every moment of the day and night for a long period of time, but I think that it will be accepted as the best possible negative evidence if it can be shown that a man has lived many years in the same community, has been well known, and has maintained the reputation of a total abstainer during that time. I think that every one will agree that it would not be possible for a man to live forty years in a small community, maintain the reputation of a total abstainer, and yet drink alcoholic liquor in sufficient quantity and with sufficient regularity to excite a toxic amblyopia. In order, therefore, to ascertain the facts in regard to this patient I inquired of a number of people who had been acquainted with him for years, including his family physician, and learned that he was well known in the community, had lived there nearly his entire life, and that none of them had ever known him to drink, or had ever heard of his having

done so. His reputation as a total abstainer seems to be absolutely spotless. This is, therefore, a case in which a well-marked disease of the papillomacular bundles of optic nerve-fibers developed in a man who had smoked excessively for many years, during which he had not been known to drink any form of alcoholic beverage. Inasmuch as this disease recovered after total abstention from tobacco, as no signs of multiple sclerosis or of any other disease of the central nervous system could be detected in the course of a year, and as he has continued to enjoy good health and good vision since the cessation of treatment, the evidence seems to be sufficient to prove that tobacco alone was the exciting agent. A single case of this kind is enough, I think, to prove that tobacco *alone* is competent to cause the lesions characteristic of toxic amblyopia.

DISCUSSION.

DR. EMIL GRUENING, New York: I have never seen a case of pure tobacco amblyopia. In the central scotomata due to an affection of the papillomacular fibers, I could always point to the preponderating influence of alcohol. Dr. Van Millingen, who practised many years in Constantinople, stated, in one of his publications, that among the Mohammedans, who smoke excessively but do not drink, he never observed scotoma due to the affection of the papillomacular fibers. My Cuban friends also tell me that this form of amblyopia is unknown among them.

DR. SAMUEL THEOBALD, Baltimore: I am a poor hand at recalling cases exactly, but I am sure that authentic cases have been reported of toxic amblyopia from tobacco alone. For example, a woman engaged in a tobacco factory and constantly inhaling the tobacco dust is reported to have developed toxic amblyopia. It is very true that we can place but little reliance upon the statements of our patients. I remember a patient I had not long ago with toxic amblyopia. I inquired for the two habits—alcohol and tobacco. He admitted the tobacco, but was sure he did not use liquor

to excess. He said, "I only take one drink a day." I asked, "When do you take it?" His reply was, "Before breakfast." That, to my mind, was indisputable evidence that his statements were untrustworthy. They are more willing, of course, to admit the smoking than the drinking habit.

DR. G. E. DE SCHWEINITZ, Philadelphia: Dr. Theobald is correct in his statement that there are many cases on record in which it was believed that tobacco was the sole cause of toxic amblyopia. Cases of tobacco amblyopia have been reported in women working in tobacco factories,—for example, in Dowling's well-known paper,—and I have reported a case of this character. It is, however, very difficult to be sure that patients with toxic amblyopia are free from the alcoholic habit. My endeavor to cause central amblyopia in monkeys with tobacco was a failure, as were those with ethyl-alcohol. The blindness of horses attributed to eating the wild tobacco plant in Australia, as reported by Dr. Barrett, is interesting in this respect. The specimens from eyes blind from toxic amblyopia, which I exhibited to this Society some years ago, came from a patient in the Philadelphia General Hospital, where he had been resident for many years, and where it would be difficult, although probably not impossible, for him to obtain liquor. He smoked to great excess a very poor quality of tobacco.

REPORT OF A CASE OF PARALYSIS OF DIVERGENCE.

WILLIAM ZENTMAYER, M.D.,
Philadelphia.

According to Duane, the condition of paralysis of divergence is not so very rare. If this be so, then it would seem that it must be frequently overlooked, as the writer does not recall having previously seen a case nor has he met with one in literature since the publication of Duane's paper on this subject in 1905.

Duane, who has presented a masterly study of this affection, states that the characteristic phenomena are sudden development of homonymous diplopia with marked convergent squint, with or without vertigo, false projection, and an apparent movement of objects looked at; particularly marked diplopia for distance. The amount of diplopia and squint measured in degrees is great for distance and decreases with almost mathematic regularity as the object looked at is brought toward the patient, until at a certain definite distance there is binocular single vision. At the point where this begins there is still a slight tendency to undue convergence, but at near distances esophoria changes at first to orthophoria (equilibrium) and then almost immediately to exophoria; this exophoria increases down to convergence near-point. In almost all cases, but particularly if there is much complicating convergence excess, it will be observed that when the object of vision is brought so close that it is seen single (single vision by approximation), the patient can then still hold the images together (*a*) when prisms base in

of several degree strength are placed before the eyes, or (*b*) when the object is slowly carried off again some considerable distance (single vision by recession). The homonymous diplopia and convergent squint usually diminish somewhat as the eyes are carried to the right or left. The excursions of the eyes (even of the squinting eye) are normal in all directions. Only after the condition has lasted for some time, a slight restriction of outward movement can be observed, especially in the squinting eye. The conditions found are often strikingly stable. The deviation and diplopia may increase at first until a certain maximum is reached, then usually remain the same for months or even years.

H. A., aged thirty-three years, barber; referred to me November 18, 1910, by Dr. George G. E. Neuber, of Philadelphia. Married nine years, two children, one dead at four years. Wife has had no miscarriages. First glasses in October, 1906; second pair in April, 1907; third pair, which he is now wearing, five months ago. About June, 1907, double vision developed suddenly. Glasses ordered soon after this contained prisms, and the strength of these was increased just before he came under my care. These glasses corrected the diplopia for ordinary distances but the stars in the sky always appeared double.

Two years ago he had grip with suppurating middle ear. He has increasing catarrhal deafness. His father was deaf at the age of forty-seven, and one sister has subnormal hearing. Three years ago he suffered severe headache, possibly due to nasal polyp, the removal of which gave some relief.

He is slenderly built, and while not in robust health seldom loses time from work. His principal complaint is unsteadiness of objects and nervousness at his work. He is wearing R. E. +0.50 s.⌒+0.50 cyl. axis 90°⌒3½° pr. base out; L. E. +0.25 s.⌒+0.50 cyl. axis 90°⌒3½° pr. base out. +1 D. added for work. With glasses V. R. E. = $\frac{6}{6}$, pt.; L. E. = $\frac{6}{6}$. Accom., T. 33, 16–33 cm. With glasses esophoria is 12° for distance and 8° at 33 cm. R. H. = ¼°. Homonymous diplopia, images projected on tangent remain same distance

apart in primary position and in lateral deviation of the eyes. Without glasses esophoria is 16° for distance and 15° at 33 cm. Orthophoria at 7 cm. Distance of the images apart diminishes proportionately as the light approaches the patient. The left eye is slightly converged, but the lateral excursions of the eyes are full.

Refraction under atropin R. E. +0.75 s.⊂+0.87 cyl. axis 105°=$\frac{6}{4}$; L. E. +0.25 s.⊂+0.87 cyl. axis 90°=$\frac{6}{5}$ ($\frac{6}{4}$ normal under lighting conditions). After accommodation had been regained, it was found that he had single binocular vision at 33 cm. with 6° prisms base out before each eye. These combined with 0.25 s. less than full refraction correction were ordered for constant wear.

He got along very comfortably with these glasses until August, 1911, when he complained of frontal distress and pain at the infra-orbital notch. With the above glasses diplopia began at 22 cm., and continued increasingly to infinity. The double images were still of the same distance apart in the primary position and in the lateral fields, except that in the left upper field the image of the left eye is a trifle the higher. Single vision for distance was attained by an 18° prism base out, and could be held up to within 11 cm. of the base of the nose. Eight degree prisms base out before each eye were now combined with the distance refraction glass.

In September of this same year, while at work, he had a sense of constriction about the head, followed by a general tremor and an unsteadiness of vision compelling him to quit work. One day in the latter part of December, 1911, he had an attack of dim vision lasting about thirty minutes. Vision was so poor that he ran against persons on the street. On December 29, 1911, he had a similar attack, the dimness apparently affecting the right halves of the fields of vision. This was followed by numbness of the tongue and throat and of the right hand. The muscular condition was about the same, there being apparently a paresis of the left superior rectus muscle along with the paralysis of divergence.

At this time he was sent to Dr. T. H. Weisenburg for a neurologic diagnosis, who supplied a full report from which the following notes are abstracted: Tongue protruded straight; some coarse tremor; no atrophy. The right eye

cannot be shut as well as the left. There is distinct weakness of the right lower face when he shuts the eyes. Sensation is a little more distinct on the right side. With hands extended there is a little tremor which is somewhat coarse in character. Both hands are ataxic. Power in the lower limbs is about normal. The left knee-jerk is not so prompt as the right; this is also true of the Achilles jerk. Sensation normal, although it is somewhat diminished for touch. The symptom-complex so far indicates a lesion on the left side, as indicated by the temporary right hemianopsia and right numbness.

The Wassermann reaction having been found to be positive, he was placed upon a long course of mercury given principally hypodermatically and extending interruptedly up to the present time.

The patient was exhibited and the character of the diplopia demonstrated at a meeting of the Section on Ophthalmology of the College of Physicians of Philadelphia, April 17, 1913. The conditions present at that time were as follows: At 6 m., with the eyes in the primary position, the homonymous images are 1 m. apart; at 3 m., 48 cm.; at 1.5 m., 20 cm.; and single vision at 15 cm.; crossed diplopia at 7 cm. The images are no longer the same distance apart on a tangent in the lateral fields, but are closer by 15 cm. in the right field. In the left upper field the image of the left eye is the higher, but the images become level just below the horizontal meridian. In the right upper field the image of the right eye is a shade (1 cm.) the higher, and about level in the horizontal meridian.

At 6 m., the images are fused by a 19° prism; at 3 m., by a 17° prism; at 1 m., by 17° prism, and at 0.5 m., by a 15° prism. Orthophoria with Maddox rod, 11 cm. Single vision by approximation, 15 cm., and by recession, 17 cm. With glasses containing 8° prisms bases out, single vision by approximation 12 cm., and by recession 29 cm. At 15 cm. (point of single vision by approximation) double vision is again produced by a 2° prism base in.

SOME STRIKING EXAMPLES OF SUBNORMAL ACCOMMODATIVE POWER.

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Twenty-two years ago, in a paper read before this Society, and published in the "Transactions" for 1891,* I first described the condition for which the name "subnormal accommodative power" was suggested—a condition which I then believed to be, and now, with more extended experience, know to be, "a not infrequent cause of asthenopia in young persons." Three years later, in a shorter communication to this Society, † I reported several typical cases of this condition, and mentioned, as bearing upon the relative frequency of its occurrence, that in 1615 consecutive cases of refractive and muscular anomalies met with in private practice which I had then recently tabulated, the presence of subnormal accommodative power, more or less marked, was noted 155 times, about 9.5 per cent. of the whole number of cases. More recently I have gone over the notes of 200 cases—many of them being those of persons beyond the presbyopic age, in whom the condition can seldom be recognized—included under the letters A and B in a later series of refractive and muscular faults, and found 22 cases of subnormal accommodative power, a little over 10 per cent. of the total.

As my views regarding the nature of this anomaly, and the means of detecting and dealing with it, were fully set forth in the first paper upon the subject, to which I have

* Vol. vi, p. 127. † Vol. vii, p. 138.

referred, and more recently in my treatise upon "Prevalent Diseases of the Eye," I shall not lengthen this communication by repeating much that has already been said, but will content myself with the statement that the doctrine of subnormal accommodative power is based upon the observation that, while the normal balance of the lateral muscles of the eyes in distant vision, as shown by the vertical diplopia test, is one of orthophoria, in near vision (at the usual reading distance) the normal condition, as shown by the same test, is one of exophoria, there being usually a relative divergence of 3° to 4°. In other words, with induced vertical diplopia, exophoria of moderate degree at the reading distance is the real orthophoric condition, while "orthophoria," using the term as it is commonly employed, when present in near vision (with vertical diplopia), is a departure from the normal and is to be regarded as truly a heterophoric condition. Expressed in another form, the vertical diplopia test at the reading distance should show, as compared with the result at 20′, a difference in the sense of exophoria of 3° to 4°. When this is not the case, subnormal accommodative power exists, and if the difference is 0° or but 1°, it must be taken into account in the adjustment of glasses if the patient is to obtain comfortable near vision.

In this connection it may be of interest to mention that Mr. F. W. Weymouth, a graduate of Leland Stanford University, who during the past winter has been engaged in post-graduate work under Professor W. H. Howell, in the physiological laboratory of the Johns Hopkins University, has recently made a study of the muscle balance, the range of accommodation, etc., of the eyes of 40 students in the Johns Hopkins Medical School. His carefully conducted measurements showed for the whole number of eyes tested an average esophoria, in distant vision, of a small fraction of a prism-diopter, whereas, in near vision, at 32 cm., he found an average exophoria of 5.02$^{\Delta}$, a difference, in striking

conformation of the view commonly held by ophthalmologists, of slightly more than 5^A.

A goodly number of my ophthalmological confrères have been sufficiently impressed by the views I have advanced regarding the significance of subnormal accommodative power to put them into practice, and from some of them I have received gratifying reports as to the satisfactory results which they have obtained from doing so; but, judging from my clinical experience, a considerably larger number, it would seem, have not been so impressed. And, taking a narrow view of the matter, perhaps I should not complain of this, since it has afforded me not a few opportunities to relieve troublesome cases of asthenopia, when their efforts have been without avail.

I might cite a large number of cases in which the prescribing of glasses for subnormal accommodative power has proved most helpful, but it has seemed to me that a brief description of a few typical and striking examples of this anomaly would be more to the purpose.

CASE I.—Mr. H., aged forty-two years, engaged in newspaper editorial work in Philadelphia, and, therefore, compelled to use his eyes a great deal, especially at night, consulted me in January of this year. His asthenopic symptoms were very pronounced, and he feared he would have to abandon his profession. He had, not long before, consulted an eminent ophthalmologist in his own city, who had given him glasses for near vision which corrected a low degree of astigmatism, and slightly overcorrected his manifest hypermetropia, from which he derived but little relief.

With lenses which fully corrected his manifest fault and gave him $\frac{20}{15}$ vision, I found his muscle balance at 20 feet, by the vertical diplopia test, varied from slight exophoria to orthophoria; but, when the test was repeated at the reading distance, 13 inches, marked esophoria was revealed, which, even with the addition of sph. +.62 to the distance correction, amounted to $4\frac{1}{2}°$. When sph. +1.37, instead of sph. +.62, was added to the distance lenses, his near muscle balance

varied from "orthophoria" (so called) to esophoria of $\frac{1}{2}°$; and in reading he willingly accepted, in addition, 3° of esophoric correction.

For distant vision lenses were prescribed as follows: R. E. +.75s. ⊖—.50 c. axis 95°; L. E. +.37s. ⊖+.37c. axis 130°, and for near vision: R. E. +2.12s. ⊖—.50 c. 95° ⊖prism $1\frac{1}{2}°$ base out; L. E. +1.75s. ⊖+.37c. 130° ⊖prism $1\frac{1}{2}°$ base out. Although he has not worn the distance lenses systematically, as advised, his asthenopia has been completely relieved by the near glasses, and, up to the present time, he has been able to continue his editorial work with comfort.

It would be difficult to find a more typical example of subnormal accommodative power than is afforded by this case, or a better illustration of the benefit which results from its recognition and correction. Probably, because of congenital insufficiency of the ciliary muscles, an inordinate accommodative effort was required to maintain distinct near vision; but, because of the close relation between the accommodative and convergence centers, a strong stimulation of the ciliary muscles was necessarily accompanied by a corresponding stimulation of the internal recti, hence the esophoria, present only in near vision, and hence, also, the asthenopia, which commonly manifests itself, as is generally recognized, when the normal parallelism between convergence and accommodation is radically disturbed. The glasses prescribed, which afforded a considerably greater measure of help to the ciliary muscles than the refractive fault or the age of the patient called for, while, at the same time, they appreciably lessened the tension upon the hard-pressed external recti, relieved the asthenopia by restoring this normal parallelism.

It is interesting to note that two children of this patient, aged respectively nine and seven years, exhibit, to a less degree, the same fault as the father, for which both are wearing glasses.

CASE II.—Mr. A., aged twenty-six years, a medical student in Johns Hopkins University, although his hypermetropic astigmatism had been accurately corrected, still complained of asthenopia in near vision. In explanation of this he was found to have well-marked subnormal accommodative power. The glasses finally decided upon for distance were: R. E., +.50c. 15°; L. E., +.62c. 160°. With these he had, for the two eyes, $\frac{20}{15}+$ vision, and at 20 feet an esophoria of 1°; but at 12 inches an esophoria of $3\frac{1}{2}°$ was found. The addition of sph.+1 to the distance correction sufficed only to eliminate this esophoria, and, theoretically, he should have had a stronger spherical lens than this, or some esophoric prismatic help, for near vision. It was decided, however, to try the effect of adding sph.+1 to the distance lenses, and this proved entirely successful; and to the present time he has been using these in near vision, and doing much hard work with his eyes, without discomfort.

CASE III.—Mr. B., aged twenty-three, a student in the Johns Hopkins Medical School, with decided asthenopia and occasional diplopia in near vision, had consulted a well-known oculist in Washington, who prescribed for near vision: R. E. —.12s. ⊂—.50c. 170°; L. E. —.25c. 180°. As these failed to relieve the asthenopia, he subsequently came to me. Upon testing his muscle balance he was found to have, with these glasses, an esophoria at the reading distance of 5°. Without glasses, an esophoria at 20 feet of 1°, scant, was found—definite proof of subnormal accommodative power. He was given for near use: R. E., +.50s. ⊂+.37c. 75°; L. E., +.87s. With these he showed an exophoria at 12 inches which varied from 1° to 0°. His asthenopia promptly disappeared. Some months later there was a return of the symptoms, when a change in the astigmatic correction, but not in the spherical, was found to be necessary.

CASE IV.—Miss D., aged nineteen years, was asthenopic and suffered with severe headaches. She was found to have a low degree of compound myopic astigmatism, complicated by pronounced subnormal accommodative power. For distance, glasses were ordered as follows: R. E. —.12s. ⊂—.25c. 90°; L. E. —.37s. ⊂—.25c. 50°. With these she had $V = \frac{20}{18}$ and orthophoria at 20 feet; but at 12 inches an

esophoria, varying in degree, but at times amounting to 6°, was revealed. With sph. +1.25 added to the distance correction there was still no exophoria at the reading distance. For near vision the following were prescribed: R. E. +1.12s. ⊖—.25c. 90° ⊖ prism 1° base out; L. E. +.87s. ⊖—.25c. 50° ⊖ prism 1° base out. As she was not heard from again, it is fair to presume that they afforded the desired relief.

It may be mentioned as of interest that this patient had been in the habit of holding a book, in reading, very close to the eyes, as though she were highly myopic, a circumstance not very unusual in high degrees of subnormal accommodative power. The explanation of this paradox evidently is that the individual finds the greater accommodative effort required in doing this more than offset by the greater compensating convergence which attends it. When the proper convex glasses are given, the habit promptly disappears, and the book is held at a normal distance.

It seems unnecessary to lengthen this paper with further reports of cases, for those which I have briefly described suffice to make clear the significance of the anomaly, the tests depended upon to reveal its existence, the annoying asthenopic symptoms to which it gives rise, the measures demanded for its correction, and the immense relief which these measures invariably afford; and this was all I had in view in bringing the subject once more to the attention of the members of the Society.

THE EYE EXAMINATION A HELP TO DIAGNOSIS OF COMMENCING ARTERIOSCLEROSIS.

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During recent years oculists have felt increasing confidence in making the diagnosis of arteriosclerosis by an examination of the fundus of the eye. Pathologic research has strengthened and supported the opinions of clinical observers as to the meaning of certain appearances of the retinal arteries. Our convictions being well established in our own minds, we must endeavor, in the immediate future, to impress upon the general practitioner the value of the ophthalmoscopic examination. The most important thing is to detect the pathologic conditions in its very earliest stage. Few physicians realize how fine a test it is possible for us to make with the ophthalmoscope. Using the so-called "upright image," we can observe, several times magnified, the tiniest arterial terminal twigs. It is because we can see slight diseased conditions of retinal arteries that often the first hint of trouble may come from the ophthalmologist.

The classification of Alleman* which follows can hardly be improved upon, and proved practical for the study of the following 40 cases.

GROUP 1.—Tortuosity of the smaller arteries and their terminal twigs. No organic disease of these vessels; no indentation at the crossings, nor is the vessel-wall visible. This group includes the class of cases which are dependant, according to de Schweinitz, upon slight arteriosclerosis

*Alleman: *Jour. Amer. Med. Assoc.*, 1904.

alterations of the general arterial system. The only way in which they are demonstrable is by noticing a slight brick-red color of the optic disc, with a dilatation and tortuosity of the smaller arterial twigs, particularly in the macula, and it may be a few spots of hemorrhage and degeneration here and there in the retina.

GROUP 2.—Same as the above, only the upper artery, at the point of crossing, will show a distinct bend upward; the lower vessel is not obscured by the coats of the one above—in other words, both vessels appear as red lines. It is under this heading that he places the slight spasms of the arteries which will sometimes come and go while the vessel is under observation. There is a certain number of patients who complain of a sudden loss of sight and who, at the first examination, will show a decided diminution of one or more of the smaller arterial twigs. These cramps are probably due to an irritation of the arterial wall through some vasomotor influences. The spasms are generally confined to a part of any one branch, and eventually will pass off without any further damage than that due to the alteration in the wall of that particular twig.

GROUP 3.—If the tortuosity of the vessel-wall is not seen, it is safe to assume that the condition has been present and that it has passed on into the present appearance of the arteries. The upward bend of the artery at the crossing is more marked, and, although the underlying vessel cannot be said to be obscured, yet there is often a slight haze about the upper vessel which is made out only upon careful examination. There is no real thickening of the coat of the artery visible. Spasmodic contractures of the arteries are not the rule, but often small hemorrhages are seen, or else the remains of old ones, showing white spots in the retina.

GROUP 4.—This includes all the vascular changes in albuminuric, diabetic, and hemorrhagic retinitis. The

diseased condition of the artery is easily seen, the rigid walls causing a marked indentation of the underlying vessel and a partial obliteration of that same artery. The coats of the artery appear as two white streaks which border the vessel or, in extreme cases, make the artery appear all white—the so-called "silver-wire artery."

He lays stress on the slight haze which seems to cover and to obscure the underlying vein when it is depressed by the sclerosed artery. If this haze is demonstrated, and, at the same time, the wall of the overlying artery can be seen, then it seems to me that we can feel quite sure of our diagnosis. In my cases I have observed this depression of veins by the arteries much more frequently than the tortuous terminal arteries.

The cases comprising this report have been further divided into three groups:

GROUP 1.—Where the diagnosis of arteriosclerosis was made and the patient subsequently died from a cerebral hemorrhage—9 cases.

GROUP 2.—Typical symptoms, where a definite diagnosis was made—17 cases.

GROUP 3.—Suggestive signs present. Often only one examination of the eyes was made or other data were lacking in order to make a more definite diagnosis—14 cases.

GROUP 1.—This group of 9 patients is the most important of all in the series because the record is complete. Although most of these diagnoses were confirmatory, in one instance the arteriosclerosis was unsuspected before the eye examination was made.

An unmarried woman, aged fifty-eight years, consulted me July 21, 1908. She had suffered from attacks of temporary blindness and claudication, lasting a few seconds each time, during the past six months. Four months ago she had occipital and then, more recently, frontal headaches. One year previously her physician had found a

small amount of pulmonary tuberculosis. Examination of her eyes showed R. E. V. = $\frac{5}{6}$; corkscrew terminal arteries toward the macula and a blurred edge of the optic disc. L. E. V. = $\frac{5}{6}$; a branch of the superior vein was depressed at its crossing by the sclerosed artery. The disc was obscured like the right one.

The second and last visit was made July 28, 1909. There was no further decrease of vision, and the fundus examination confirmed the previous one made. There was no doubt of the diagnosis of arteriosclerosis. Her general health seemed improved, and, with less coughing, her weight had increased. Later her brother informed me that his sister had died in March, 1911, from a cerebral hemorrhage. Several days before the end she was almost completely blind; then the sight seemed to return sufficiently for her to recognize her friends—all this variation most probably was caused by spasm of the retinal arteries. After the first, and again after the second, eye examination, I told the brother about the circulatory disturbance, so that the family was forewarned.

As a typical example of the confirmatory diagnosis case the following hospital case is given:

Man, aged twenty-six years, admitted to the Cambridge Hospital November 17, 1908. Diagnosis: chronic interstitial nephritis. There was no decrease of vision of either eye. The heart was normal; urine analysis gave the quantities varying between 2550 and 3300 c.c.; albumen slight trace; few hyaline and fine granular casts; few renal cells with blood-corpuscles and a small amount of free fat in the sediment. In 1908 the patient was operated upon for hernia at this hospital, but no record of urine analysis was found under that date, and apparently the symptoms of nephritis are of only three months' duration. Blood-pressure, 190 on November 19, 1908; 155 on November 27, 1908. This decrease was very largely due to nitroglycerin.

My examination of his eyes was made November 21st; R.E., optic neuritis, with small flame-shaped hemorrhages about the macula; L.E., more optic neuritis than in the

right eye; some veins depressed by arteries at the crossings and others covered by exudation. The exudation and small retinal hemorrhages were situated near the macula. This appearance corresponded to Group 4. Edema of lids was noted one week later. The patient then failed rapidly, and died December 8, 1908.

GROUP 2.—If the above cited cases are considered a "finished group," we have equally exact information about almost all this second group. Although the number is small, still we have definite data, often extending over a period of several years, so that there is little guessing about the present condition of the patients. Upon this very point emphasis was laid by Dr. F. T. Rogers, of Providence, in a discussion of a paper by Dr. A. E. Bulson, Jr. * In a study of cases of this nature we must be able to follow the progress of the disease, and, on that account, private cases have been mostly selected because the records were much more complete. An occasional hospital case was followed up and is here included.

Most of the patients now under consideration are apparently healthy, and are more or less actively employed in business or household affairs. Roughly, they may be divided, as in Group 1, into a group where the condition of arteriosclerosis was unsuspected and where the ocular diagnosis was confirmatory. We remember how, in the past, the first diagnosis of chronic nephritis was made by the oculist. Today the same is true of discovering the first truly definite symptoms of arteriosclerosis by a careful examination of the retinal arteries. Particular emphasis is laid on this fact. Experience gained during the past years has given assurance to make this diagnosis, especially after some of the patients, who had been seen months or even years before, had died from apoplexy.

*"Some Early Diagnostic Signs of Arteriosclerosis and Chronic Bright's Disease," A. E. Bulson, Jr., *Jour. Amer. Med. Assoc.*, September 21, 1912.

Let us select from among these individuals the five who did not suspect any such complication as arteriosclerosis to be present. All considered themselves in good health when the first eye examination was made. Within five years two have died from cerebral hemorrhage; one has exophthalmic goiter, a rather obscure case, and one has chronic interstitial nephritis, and within the past six months has passed through a severe acute exacerbation of this disease; in other words, he is a doomed man. This leaves only one, who is, to all intents and purposes, still healthy.

Man, aged forty-seven years, consulted me in August, 1908, complaining only of presbyopic symptoms. The examination of his eyes showed corrected vision $\frac{5}{5}$ in each eye, the fundus and muscular balance normal. No further examination of his eyes was made until September, 1912. The vision remained normal. The right fundus was normal. The left fundus showed an area of old retinitis close to the optic disc, looking very much like a posterior staphyloma. Above the disc one vein was depressed by the artery at the crossing. This suggested the early stage of arteriosclerosis. I mentally reviewed what he had told me at different times about his work. As a post office inspector, he had taken no vacation in the past ten years. He traveled constantly about New England, but had taken no regular exercise. He considered himself to be in absolutely sound mental and physical vigor, and could hardly credit my statement that rest was imperative. Being a sensible individual, it seemed best to explain more or less in detail the significance of the disturbed ocular circulation. If any good is to be done this class of patients, it is essential that the truth shall be told, in a circumspect manner, to as many as it seems possible or advisable. The fear of being discredited later and being considered alarmists should not detain us from using our common sense in this regard. Further, this patient was told that if he persisted in keeping on with his work, real damage would be done to his eyes and his ability to work crippled. I knew of his longing to return to his old home on Cape Cod, and urged a rest there. Upon being referred to

Dr. A. H. Blake, of West Somerville, he received the same advice. The doctor's examination showed the heart and kidneys in normal condition, but the blood-pressure was 175 to 180.

In January, 1913, Dr. Blake reported to me that the patient's general condition was improved, the blood-pressure having dropped to 130, and subsequent examination of the urine had confirmed the first negative finding. Among other things, he told how, during the winter of 1911–12, he was nearly distracted by the critical sickness of his only daughter. He considered this intense worry an important causative factor in starting the arteriosclerosis. He agreed that the man needed a complete change of living and less exacting duties. The patient agreed to give up the hard inspection work, and eventually will settle in his old home. When this occurs, the result should be entirely satisfactory.

What was the reason for considering that this apparently healthy man had commencing arteriosclerosis? While the first eye examination was negative, the second, four years later, showed the combination of a depressed vein at the crossing—a small area of old retinitis with raised blood-pressure, enough to make a definite diagnosis.

Somewhat in contrast to the above case is the following one. Details are given because it is a characteristic case where the ocular diagnosis was confirmatory of a grave disease:

Man, aged fifty-six years, was seen February, 1912. He complained of slight occipital pain during the past four months. The corrected vision in each eye was better than $\frac{5}{5}$. The muscular balance was normal. The right fundus was normal, the left one showed a retinal hemorrhage above the disc, and depression of veins at the crossings characteristic of Group 3. For a great many years he had worked hard, day and evenings, in retail business, and had assumed most of the responsibility during the past few years. During this long period he had taken no rest or recreation of any kind. He was told the significance of the retinal hemorrhage; that it was imperative

for him to give up evening book-keeping and to get more help in the store. He consulted one physician, whose examination was not satisfactory. In May, 1912, it was seen that fresh hemorrhages had occurred in the left fundus, and on that account he was sent to Dr. F. W. White, of Boston, whose report, dated May 15, gave as his diagnosis, arteriosclerosis with chronic interstitial nephritis. Two examinations of the urine showed slight amounts of albumen and characteristic casts. The blood-pressure was 185. The patient was started upon sodium nitrate to reduce the high blood-pressure and also a special diet.

The causes of nephritis in this man are the same as in many other business men, *i. e.*, worry, close attention to minute details of his business, and lack of exercise, so that he was "flabby." He had never indulged in alcoholic or venereal excesses.

Another physician, a friend of the family, has given me the subsequent history. The patient was desperately sick with acute exacerbation of his nephritis, but in January, 1913, had so far recovered that he had resumed his business.

In order to show some other characteristic features of this disease the details of this third case are here inserted:

Woman, aged thirty-three years, was referred to me in January, 1907, by Dr. R. W. Guiler, of Newton Highlands. Six months before I saw her she suffered a great deal with very obscure and persistent headaches. At that time she was seen in consultation by Dr. F. C. Shattuck, of Boston. Nothing definite was decided at that time. She complained to me of moderate left frontal headache and a strained feeling over the two eyes. The corrected vision in each eye was normal. All other tests were normal, including the fundus. Two and one-half years later I made the second examination. The vision still remained normal. In the fundus of the right eye a depression of the lower branch of the vein by its artery; in the right fundus nothing was seen. She had gained 40 pounds in weight, and considered herself in good health again. The third examination was made almost three years later, on May 3, 1912. The

fundus change in the right eye was confirmed, but nothing definite noted in the left eye. The two examinations made me feel, however, that the changes of the right fundus were certainly suggestive of arteriosclerosis, and this opinion was written immediately to Dr. Guiler.

In January, 1913, Dr. Guiler reported to me as follows: In May, 1912, the patient, having gained in weight and complaining of a return of the old kind of headaches, he found the blood-pressure 160. As the result of keeping her on a strict diet she lost, during the following seven months, 25 pounds, and in consequence felt better in every way again. The following record of blood-pressure tallies with the cessation of headaches and the gain in bodily vigor: May, 1912, 160; June, 140; July, 132; August, 120; September, 118. An excessive amount of uric acid was the only abnormal feature of the urine examination made during this active dietetic treatment.

During the six years' period of observation of this patient it has been possible first to suggest, and later confirm, the diagnosis of commencing arteriosclerosis. When the increased blood-pressure was found, we both felt convinced that this diagnosis was correct. The prognosis seems favorable; it seems reasonable to suppose she will remain in fairly good condition for several years.

GROUP 3.—This includes all the suggestive and more or less indefinite cases. Many of these patients were examined only once, consequently there was no opportunity to verify the first tentative diagnosis. The cases represent the very earliest symptoms of arteriosclerosis, and it is only after the lapse of years that a more definite diagnosis can be made at subsequent examinations. It seems best to include all cases, because many included in Group 2 were observed to pass through similar phases. It must be conceded that there would be a difference of opinion if two observers should examine such a patient. One might pass the patient as showing no abnormality of the fundus circulation, while the second would consider it as suggestive of commencing arteriosclerosis.

Blood-pressure records, unfortunately, have not been taken in the majority of the patients. Considering the whole group, this omission does not lessen the value of the diagnosis, because the close similarity of symptoms is very apparent.

Although the individuals were generally told of the eye conditions and received instructions for improved general regimen, hardly any were referred to their regular physicians. Three patients had already consulted a doctor on account of cardiac symptoms. With the rest, it seemed wiser to wait for a general physical examination until a more opportune time. Almost every individual sought relief only of eye-strain symptoms, the most persistent and frequent ones being frontal headache and dizziness. The future may prove that among just such cases the first hint of approaching arteriosclerosis will be obtained. During an average interval of five years there has been apparently little or no development of new symptoms. This is partly explained because the average age of these individuals was forty-four at the time of my first examination.

Some details of the records of the following two cases are given because more than one fundus examination was made:

Woman, aged thirty-seven years, consulted me in November, 1907. Three months previously she had an attack of influenza, and since then had often been overcome by attacks of dizziness, vortex headache, and a faintness. These would come while she was sitting, and, in fact, two attacks came in quick succession during the examination at my office. She was told by her physician that her heart was normal. There was a history of three miscarriages, most probably due to syphilis. The patient was stout and flabby. The corrected vision almost $\frac{5}{6}$ in each eye. The right fundus was normal, the left showed a slight venous congestion. In February, 1908, the next examina-

tion was made. Right eye: At the crossing of the superior branch of the artery the vein was distinctly seen to be at a lower level, the vein appearing blurred on either side of the artery. Another smaller vein below the disc had about the same appearance. Left eye: A macula of cornea made all details blurred, but it was possible to be sure of a venous congestion and hyperemia of the disc. This suggested for the first time the earliest stage of arteriosclerosis. At the examinations in March and May this opinion was confirmed. During the entire six months that the patient was under observation the vision varied between $\frac{5}{6}$ and $\frac{5}{8}$ in each eye.

Woman, aged forty-seven years, consulted me February, 1908, complaining only of chronic conjunctivitis. The corrected vision in each eye was almost $\frac{5}{6}$. Reading glasses were prescribed. Right eye: Fundus normal. Left eye: Near the disc the arteries twisted about the veins and seemed to depress the latter. A provisional diagnosis of arteriosclerosis was made. One month later, upon making a second and careful fundus examination, the left disc showed a certain amount of venous congestion. The opinion was confirmed in regard to the depression of the veins under some of the arteries. No change in right eye. This opinion was written to her family physician, who agreed that other nervous symptoms were most likely due to arteriosclerosis. She had some cardinal symptoms of exophthalmic goiter also.

If we compare this record with that of Case No. 16 (Group 2), we see that the early-stage symptoms of the latter were not one bit more definite. It seems as if most of the patients in this third group had no more exact symptoms, either subjective or objective. These cases indicate very clearly the manner in which a diagnosis of arteriosclerosis can be made. The patient, apparently healthy and robust, comes to obtain relief from what appears to be eye-strain headache. During the examination of the fundus there is the merest suspicion that certain retinal arteries do not look quite normal. After months

or years the patient is seen again, and the suspicion changes to a strong suggestion that arteriosclerosis has really started in one or both eyes. At this time it is important to gather all data. The blood-pressure should be taken, and the history of the patient's mode of living and general and physical health noted. It is particularly important to take a record of such symptoms as frontal headache, claudication, and fleeting attacks of blindness or dizziness. Sometimes other members of the patient's family will describe a change of disposition or nervous irritability.* Among men patients we must take into consideration a worrying temperament, especially the man who never takes any rest from his business, particularly if such an individual indulges quite freely in alcohol.

The question of making the diagnosis having been disposed of, we must now turn our attention to an equally important matter, namely, what kind of a warning shall we give our patients? A warning by the ophthalmologist should be given, even if we do not think there is any immediate danger to the patient's life. Many of these patients in the third group would not consult a physician. Under the circumstances it is our duty to tell the patient about future damage to the eyes should they persist in living and working without any change. Many leading Philadelphia oculists considered this a very important part of their treatment of such cases.†

* All these nervous symptoms were found by Walton and Paul in the neurological clinic of the Massachusetts General Hospital.—*Jour. Amer. Med. Assoc.*, January 1–18, 1908.

† At a meeting of the Philadelphia Polyclinic Ophthalmic Society, May, 1912 (*Annals of Ophth.*, July, 1912), Dr. D. Forrest Harbridge presented a paper entitled "Ocular Manifestations of Arteriosclerosis." In the discussion Dr. Posey said: "As regards prognosis, he maintained that, while vision might be preserved many years through repeated attacks of blindness, yet final blindness was to be dreaded on account of the thrombosis of the retinal artery. Several of his patients had died, several years later, from vascular disease of the brain. He insisted upon treatment and regimen to control the arteriosclerosis in all cases."

Peter gave some interesting tables showing patients selected from

The danger of permanent blindness perhaps has been exaggerated. Very often the patient dies from apoplexy before any serious decrease of vision occurs. In order to make this point especially clear, the following table of Group 1 cases has been prepared:

TABLE 1.—INCLUDING ALL CASES OF GROUP 1.

Case Number.	Age.	Vision at First Examination. R.	Vision at First Examination. L.	Diagnosis.	Vision at Second Examination. R.	Vision at Second Examination. L.	Time Intervals. Between Eye Examinations.	Time Intervals. Between Last Eye Examination and Death.	Total Period of Observation.
1	38	Without glasses 5/5	Without glasses 5/4—	Class II. R. Distinct depression veins at crossings, blurred disc. Terminal arteries not especially tortuous. L. no definite change.	..	..	None.	3 yrs. 10 mos.	3 yrs. 10 mos.
2	66	Without glasses 5/18	Without glasses percep. light.	Class IV. R. Recurrent hemorrhagic retinitis. L. Separation of retina eight years ago, after hemorrhagic retinitis.	Without glasses 8/40	Without glasses percep. light.	4 yrs.	2 mos.	4 yrs. 2 mos.
3	37	With glasses 5/4—	With glasses 5/5+	Classes III and IV R. Veins depressed and obscured by artery at crossing. Old hemorrhagic spots and minute yellow spots of exudation. L. the same.	With glasses 5/5+	With glasses 5/4—	6 mos.	3 yrs. 10 mos.	4 yrs. 4 mos.
4	26	Vision not recorded. Patient in bed; apparently sees well.		Class IV. R. Optic neuritis. Retinal hemorrhages. L. Optic neuritis. Depression veins by arteries; retinal exudation and hemorrhage near macula.	Blood-pressure, 190; eight days later, 155.		None.	17 days.	17 days.

several hundred cases where an average high blood-pressure was found in cases now under discussion.

26	cases	retinitis with arteriosclerosis.	Average	blood-pressure,	165
49	"	neuroretinitis with arteriosclerosis.	"	" "	185
6	"	hemorrhagic retinitis with arteriosclerosis.	"	" "	205
3	"	albuminuric retinitis without arteriosclerosis.	"	" "	190
3	"	albuminuric neuritis without arteriosclerosis.	"	" "	225

The 6 non-sclerotic cases were for comparison.

TABLE 1.—INCLUDING ALL CASES OF GROUP 1.—(*Continued.*)

CASE NUMBER.	AGE.	VISION AT FIRST EXAMINATION. R.	VISION AT FIRST EXAMINATION. L.	DIAGNOSIS.	VISION AT SECOND EXAMINATION. R.	VISION AT SECOND EXAMINATION. L.	TIME INTERVALS. Between Eye Examinations.	TIME INTERVALS. Between Last Eye Examination and Death.	TOTAL PERIOD OF OBSERVATION.
5	66	With glasses 5/10—	With glasses 5/10+	Class II. R. Moderate depression veins; disc blurred. L. superior branch of artery contracted and superior branch of veins congested.	With glasses 5/10+	With glasses 5/6—	3 mos.	5 mos.	8 mos.
6	69	With glasses 5/7.5	With glasses 5/7.5+	Classes I and II. R. Depression veins. L. Terminal arterial twigs tortuous.	..	..	None.	3 mos.	3 mos.
7	52	With glasses 5/4—	With glasses 5/40	Class II. R. Light reflex on artery very broad. Slight depression of some veins. Exudation covers artery. L. Ametropia since childhood.	With glasses 5/4—	With glasses 5/16—	16 mos.	1 yr.	2 yrs. 4 mos.
8	58	With glasses 5/6	With glasses 5/6	Class II. R. Tortuous terminal arteries, disc blurred. L. Upper branch veins depressed, disc blurred.	With glasses 5/6	With glasses 5/6	1 yr.	1 yr. 9 mos.	2 yrs. 9 mos.
9	72	With glasses 5/7.5—	With glasses 1/36	Class IV. R. Simple retinitis; disc blurred. L. Thrombosis central vein. Veins depressed at crossings and much congested.	With glasses 5/15+	With glasses percep. light.	12 mos.	3 yrs.	4 yrs.

In 7 of these cases the eye examination gave a confirmatory diagnosis. In 2, the ocular diagnosis gave a first hint of a commencing arteriosclerosis. The longest observation period of the confirmatory diagnosis kind was No. 2. The left eye was afflicted twelve years before his death (my own observation of his right eye extended through four years and two months of this time). Where the ocular diagnosis gave the first hint of trouble, two years and nine

months' observation of No. 9 was the longest time. Case 8, with almost identical characteristics, lasted two years and four months. The shortest period—seventeen days—was in No. 4, a confirmatory diagnosis.

One examination was recorded in Cases 1, 4, 6. After the death of Cases 1 and 6 Dr. R. W. Guiler, the family physician, informed me that there had been no appreciable reduction of the vision. The same was true of No. 4, who died at the Cambridge Hospital of chronic interstitial nephritis without becoming actually blind.

One-third of all these patients became partly blind before death. The other two-thirds retained really excellent vision to the end.

The question of how long good vision will last is next in importance to the prognosis for the patient's life. Tables 1 and 2 answer both questions satisfactorily. It must not be forgotten that many patients in the Table No. 2 still are apparently healthy and well. On that account they offer a good comparison with the patients in Group 1. Vision records of hospital patients are lacking, but blood-pressure is given.

TABLE 2.—INCLUDING ALL CASES OF GROUP 2.

Case Number.	Age.	Vision at First Examination. R.	Vision at First Examination. L.	Diagnosis.	Vision at Last Examination. R.	Vision at Last Examination. L.	Time Interval Between Eye Examinations.	Total Period of Observation.	Physical Examination.
1	56	With glasses 5/4—	With glasses 5/5+	Classes II and III. R = normal. L = small retinal hemorrhages near disc. Distinct depression three veins.	With glasses 5/4	With glasses 5/5+	3 mos.	12 mos.	Chronic interstitial nephritis with secondary hypertrophy heart. B. P. = 185.
2	47	With glasses 5/5+	With glasses 5/5+	Classes II and III. R = normal. L = small area of retinal atrophy. Depression vein just above disc.	With glasses 5/4—	With glasses 5/5	4 yrs.	4 yrs. 5 mos.	Urine analysis twice found negative. Heart, normal. B. P. = 180.

TABLE 2.—INCLUDING ALL CASES OF GROUP 2.—(*Continued.*)

Case Number.	Age.	Vision at First Examination. R.	Vision at First Examination. L.	Diagnosis.	Vision at Last Examination. R.	Vision at Last Examination. L.	Time Interval Between Eye Examinations.	Total Period of Observation.	Physical Examination.
3	67	With glasses 5/4—	With glasses 5/5—	Class II. R. Flocculi corpus vitreum. Depression veins at crossings. L. Same as R.	No subsequent complaint of decreased vision.		None.	7 yrs. 6 mos.	Chronic nephritis. Heart slightly enlarged; no murmurs.
4	56	With glasses 5/5	With glasses 5/5—	Classes III and IV. R. Optic neuritis swelling 4 D. Distinct depression veins. Retinal hemorrhage and exudate. L. same as R. Tortuous terminal arteries.	With glasses 5/4	With glasses 5/4	4 yrs. 3 mos.	8 yrs. 2 mos.	Secondary chronic nephritis. Seven years after first eye examination L. hemiplegia with partial recovery.
5	33	With glasses 5/6+	With glasses 5/6+	Classes I and II. R. Very tortuous terminal arteries, depression veins. L. Tortuous arteries only.	With glasses 5/5+	With glasses 5/6+	1 yr. 5 mos.	4 yrs. 1 mo.	After childbirth temporary paralysis L. arm with recovery.
6	..	With glasses 5/5—	With glasses 5/5—	Class II. R. Depression veins at crossing near disc. L. Same as R. Blurred disc.	With glasses 5/4—	With glasses 5/5+	1 yr. 8 mos.	5 yrs.	Diagnosis of exophthalmic goiter made at time first eye examination. Heart, normal.
7	57	With glasses 5/4—	With glasses 5/4—	Classes II and III. R. Depression veins at crossings. L. Depression veins at crossings. Two small spots retinal exudate.	With glasses 5/4—	With glasses 5/4—	2 yrs.	2 yrs. 5 mos.	Examination urine and heart, negative.
8	35	With glasses 5/10	With glasses 5/15	Class IV. R. Slightly hazy disc. Superior artery slightly contracted. Retinitis albuminurica. L. Same general appearance.	With glasses 5/5—	With glasses 5/7.5	5 mos.	7 yrs.	Fundus changes followed childbirth 4 wks. ago. Satisfactory improvement of physical condition.
9	41	With glasses 5/4—	With glasses 5/5—	Class II. R. Slight depression veins at crossings with resultant congestion distal end. Blurred disc. L. Same as R.	With glasses 5/4—	With glasses 5/5—	4 yrs. 7 mos.	5 yrs.	No examination has been made. Patient in good physical condition.
10	49	With glasses 5/4—	With glasses 5/10+	Class III. R = normal. L = inferiorbranch artery almost obliterated.	With glasses 5/5	With glasses 5/8+	7 mos.	4 yrs.	Slight debility.

TABLE 2.—INCLUDING ALL CASES OF GROUP 2.—(*Continued.*)

CASE NUMBER.	AGE.	VISION AT FIRST EXAMINATION. R.	VISION AT FIRST EXAMINATION. L.	DIAGNOSIS.	VISION AT LAST EXAMINATION. R.	VISION AT LAST EXAMINATION. L.	TIME INTERVAL BETWEEN EYE EXAMINATIONS.	TOTAL PERIOD OF OBSERVATION.	PHYSICAL EXAMINATION.
11	30	With glasses 5/5	With glasses 5/5	Class II. R. Depression 3 veins at crossings, slight enlargement distal end of vein at such points. L = normal.	..	..	None.	8 mos.	Patient in very good health.
12	55	With glasses 5/4—	With glasses 5/4	Class II. R = depression veins at crossing. L = same as R.	With glasses 5/4—	With glasses 5/4—	10 yrs. 2 mos.	10 yrs. 6 mos.	Patient in very good physical condition.
13	37	With glasses 5/5—	With glasses 5/5	Class II. R. Blurred disc. L. Depression veins, above and below disc. Blurred disc.	..	..	None.	10 mos.	Treatment for chronic constipation. No report received.
14	47	With glasses 5/4—	With glasses 5/4—	Class III. R = normal. L = small area retinal exudate covering artery below disc. Tortuous and congested veins.	With glasses 5/4—	With glasses 5/4—	None.	6 mos.	Under care of physician but no report received.
15	46	With glasses 5/4—	With glasses 5/5+	Classes II and III. R. Blurred disc. Small spots retinal exudate. Tortuous arteries Depression veins L. same as R.	No subsequent complaint of decreased vision.		None.	4 yrs. 5 mos.	Chronic interstitialn ephritis. Six days after eye examination; had slight convulsion and twitching R. arm and leg with complete recovery.
16	33	With glasses 5/5	With glasses 5/4—	Class II. R. Lower branch veins depressed at crossing and covered with exudate. Blurred disc. L. Blurred disc.	With glasses 5/5+	With glasses 5/4—	3 yrs. 6 mos.	6 yrs. 2 mos.	Strict diet treatment. B. P. = 160; later 118.
17	..	With glasses 2/60	With glasses 5/6+	Classes III and IV. R. Depression veins. Retinitis albuminurica. Atrophy retinæ about macula. L = normal.	..	..	None.	10 mos.	Referred to homeopathic family physician. No report received.

It so happened that there was little difficulty in persuading three-quarters of these patients to consult their family physicians for a general physical examination. Of this number, one-third proved to have chronic nephritis. Some

of these had high blood-pressure, but, on the other hand, several individuals had only ocular signs and increased vascular tension without any lesion of the heart or kidneys. The great benefit to the patient when the high blood-pressure was reduced by diet or drugs has been mentioned in the detailed description of cases Nos. 1, 2, and 16.

The longest observation period of the confirmatory diagnosis kind, No. 4, was eight years, two months. Seven years elapsed before this man was incapacitated and forced to give up business. Where ocular diagnosis gave the first hint of trouble, five months' observation of cases Nos. 2 and 7 was the longest time. The shortest total period of observation was five months.

Included in this group are the patients (Nos. 4 and 7 to 14, inclusive) who had functional trouble with their eye muscles. As far as I am aware, there has been little previous mention made of a characteristic heterophoria. In 10 of 17 cases this trouble existed (58 per cent.). Included in this total of 10 cases are two with weakened accommodation. At first the finding of heterophoria seemed merely a coincidence, and no particular attention was paid to its possible relation to arteriosclerosis. A routine muscle balance examination was made of all office patients. Finding muscular imbalance in such a proportion of my cases, the arteriosclerosis theory seemed to offer a possible causative clue. The most logical explanation seems to be that arteriosclerosis gives an insufficient, or possibly an irregular, blood-supply to the eye muscles, with resultant impaired function. With hardly an exception the heterophoria has been persistent, judging by those individuals who have been under observation from four to five years. In spite of its obstinacy, heterophoria has not hindered one of my patients from doing a great deal of medical research. This man had in 1908 exophoria 11° and right hyperphoria 2°; combined with a slight amount of myopic astigmatism. The

vision corrected was: R.E. = $\frac{5}{4}$, partly; L.E. = $\frac{5}{5}$, partly. Four and one-half years later the exophoria was 10° and right hyperphoria was 3°. Intermittent home exercise with prisms, combined with constant wearing of prisms, gives him relief.

Recently D. F. Harbridge* laid emphasis on the fact that arteriosclerosis more or less seriously impairs all eye functions, and that "it acted as a strong index to the welfare of the general economy." Wendell Reber† has drawn attention to two new signs of arteriosclerosis of the eyes, *i. e.*, sluggish pupillary reaction and abnormal recession of the near-point (or failure of accommodation), sometimes unequal in the two eyes.

Regarding the question of impaired function from an entirely different point of view, Rudolph Schmidt‡ gives another possible explanation how arteriosclerosis may be the underlying cause. He observed that "it may be considered an established fact that disease of cardiac, gastric, or intestinal arteries may give rise to painful interferences of function. The attacks of pain must occur at the height of muscular exertion, and be accompanied by disturbance of motility in the sense of spasm and loss of function. Probably in all these conditions the organic basis of the pains consists of an active intermittent spasm of the vessels."

The variation of vision of all patients has been insignificant. Although no record of the vision of case No. 3 has been kept, this man is consulting his family physician at frequent intervals and has never mentioned any further trouble with his sight. This preservation of fine acute vision is especially remarkable in cases Nos. 1, 3, 4, and 15, every one of whom has been critically sick during the time

* Harbridge, D. F.: *Annals of Oph.*, July, 1912.

† Reber, Wendell: "Beginning Signs of Angiosclerosis," *Annals of Oph.*, January, 1909.

‡ Schmidt, R.: "Pain, its Causation and Diagnostic Significance in Internal Disease," 1908, p. 134.

of observation. It seems as if prompt medical treatment of the early stage of the arteriosclerosis had succeeded in staying ocular conditions which threatened blindness years ago (No. 4).

TABLE 3.—INCLUDING ALL CASES OF GROUP 3.

Case Number.	Age.	Vision at First Examination.		Diagnosis.	Vision at Last Examination.		Time Interval Between Eye Examinations.	Total Period of Observation.	Remarks.
		R.	L.		R.	L.			
1	23	With glasses 5/5—	With glasses 5/5+	Class I. R: Terminal arteries tortuous. L: same as R.	..	..	None.	4 yrs.	..
2	53	With glasses 5/4—	With glasses 5/4—	Classes I and II. R: Depression veins at crossings, congestion. L: Disc blurred. Depression veins Tortuous arteries.	With glasses 5/5—	With glasses 5/5—	9 mos.	5 yrs.	This man had done hard physical work many years. Occasional vertical diplopia.
3	38	With glasses 5/7.5	With glasses 5/4	Class II. R: Spasm causing decreased size inferior branch artery. L: normal.	With glasses 5/4+	With glasses 5/4+	5 yrs.	10 yrs.	Apparently in good physical condition at present time: no complaints.
4	60	With glasses 5/10—	With glasses 5/8—	Class II. R: normal. L: Upper V tortuous and depressed at crossing with distended distal end.	..	..	None.	4 yrs. 6 mos.	..
5	37	With glasses 5/5—	With glasses 5/5—	Class II. R: 2 veins depressed at crossings. L: normal.	..	..	None.	5 yrs. 6 mos.	..
6	47	With glasses 5/5—	With glasses 5/5—	Class II. R: normal. L: V congestion. Veins depressed at crossings.	With glasses 5/5—	With glasses 5/5—	1 mo.	5 yrs.	..
7	47	With glasses 5/4	With glasses 5/5+	Class II. R: hyperemic disc. Depressed veins with distended distal ends. L: same as R.	..	..	None.	2 yrs. 1 mo.	..
8	48	With glasses 5/4—	With glasses 5/5—	Class I. R: several arteries very tortuous L: same as R.	..	..	None.	3 yrs. 5 mos.	..
9	..	With glasses 5/5—	With glasses 5/4—	Class I. R: Spasm causing decreased size arteries compared with L. L: normal.	..	..	None.	4 yrs.	..

TABLE 3.—INCLUDING ALL CASES OF GROUP 3.—(*Continued.*)

Case Number.	Age.	Vision at First Examination. R.	Vision at First Examination. L.	Diagnosis.	Vision at Last Examination. R.	Vision at Last Examination. L.	Time Interval Between Eye Examinations.	Total Period of Observation.	Remarks.
10	36	With glasses 5/4—	With glasses 5/5—	Classes II and III R: disc blurred. Depression veins with V congestion. L: same as R.	..	..	None.	1 wk.	..
11	58	With glasses 5/5	With glasses 5/7.5	Class I. R: normal. L: Spasm causing decreased size of arteries.	..	..	None.	10 yrs. 6 mos.	..
12	37	With glasses 5/6—	With glasses 5/5—	Class II. R: Distinct depression vein below disc. L: normal.	..	..	None.	3 yrs.	..
13	37	With glasses 5/8	With glasses 5/8+	Class II. R: Distinct depression veins, blurred each side of artery. L: Venous congestion.	With glasses 5/8	With glasses 5/8+	7 mos.	5 yrs. 3 mos.	Macula cornea L.
14	50	Patient in bed; no record of vision.		Class III. R: Depression veins, hazy vitreous. L: same as R.	..	..	None.	6 yrs.	Enlarged heart with murmurs apex and base. Previously had slight traces of albumin in urine. B. P. = 140.

It has been previously explained why this group was added. In several instances a number of records were found in Group 3 when a critical study of all these cases was started. Generally, from information recently received from the family physician, these same cases were transferred at once to Group 2 (Cases 2, 7, 15, 16, of Group 2, are typical examples).

To my knowledge, only 3 of these patients have consulted their family doctor. However, almost all received warning that some trouble with the retinal circulation existed, and that care of the general health and avoidance of undue eye-strain were necessary.

Comparing this table with the preceding ones, it is evident that these cases offer no extra help toward prognosis,

either ocular or general. Less than a third have had vision tested more than once. The interval between such examinations in Case 3 was five years, but in the other cases a few months only intervened. First examination tests of vision were practically always normal. The same was true of second examination tests.

Finally, it seems interesting to draw attention to the fact that many of the patients in the last two groups were not over middle age. If this proves true of future observations, it will mean that we shall have a much better opportunity to give these patients early and efficient treatment. In Group 1 the ages were between fifty-eight and seventy-two years; in Groups 2 and 3, mostly between thirty and fifty years.

DISCUSSION.

DR. W. F. MITTENDORF, New York: The paper brings to my mind cases that come to us early with degenerative changes which require the assistance not only of the ophthalmologist, but of the family physician. A great many of these are not aware of the slight decrease of vision, and would go on in the ordinary routine of life until some more serious change would take place. I have taken a great deal of interest to have the arterial pressure measured in every one of these cases. One of the first indications in the treatment is to endeavor to reduce arterial pressure, which is usually high, and one of the greatest remedies in my experience for this purpose has been the application of the Russian oil of paraffin. One-half to one tablespoonful three times a day will often reduce the blood-pressure rapidly—in some cases it has fallen from 235 mm. or more to 175 or 185 mm. This is experienced principally in elderly persons who have undergone more or less hardship in work, sickness, or exposure. Another remedy which I have found grateful in these cases is the administration at the same time of the French pill, Grains de Santi, of Dr. Frank, giving one pill at bedtime. It is a vegetable compound, and an old-fashioned remedy, but it is one of value in reducing arterial pressure. The use of these remedies, together with massage

of the eyes, has been successful in a number of cases. Of course, the great remedy is outdoor life. If these patients will give up their business and go out and play golf or walk, they will be benefited materially; especially is this the case where the depression of the veins by the overlying arteries is marked. I have not been able to find much muscular disturbance in these cases, but massage of the eyes would relieve that to a certain extent. I think we should call the general physician's attention to it at once, and in that way we may not only preserve the vision, but save the life of the patient.

DR. WILLIAM ZENTMAYER, Philadelphia: Much of the importance which attaches to angiosclerosis of the retina depends upon its early recognition. One of the very earliest phenomena said to occur is the so-called locomotion pulse. This is not a contraction pulse synchronous with ventricular contraction, but one of movement of the artery itself on the plane of the retina. It belongs only to the earliest stage of the affection. I have diligently looked for it, but have never been able to convince myself of its presence. It should not be forgotten that, while usually the small twigs on and about the papilla are the first to show tortuosity at times, as pointed out by de Schweinitz, this is first to be detected in the small macular twigs of the temporal vessels. I believe that irregularity in the caliber of the veins is often one of the very earliest signs.

DR. ALLEN GREENWOOD, Boston: This subject has been particularly interesting to me, as many of you perhaps know. Last year, at the Academy, I read a paper similar to that of Dr. Williams, and drew attention to two classes of cases which are well to bear in mind. First, where the sclerosis of the vessels is largely confined to the larger arteries, you get the bending of the veins at the artery crossings, and inability to see the vein beneath; and, second, in cases where the disease is confined to the smaller vessels, you get the changes in the vessels in the macular region. One of the important symptoms in these latter is that a slight disturbance in central vision is often the first symptom, and the patient complains, in reading your test-type line, that the central

letter is raised a little above the others. I think that is quite common in such cases of arteriosclerosis.

DR. EDWARD R. WILLIAMS, Boston: I should like to have a word further to say about the question of premonitory and confirmatory diagnosis. It seems to me that making the early diagnosis is, of course, really where we are to do some good. In examining certain patients we suspect that arteriosclerosis is present; after two or three months our opinion is confirmed by subsequent examinations. Then we should write the family physician telling him the condition is very suggestive of arteriosclerosis. That is the time help can be given and the general practitioner can do better work from the very beginning. There are several examples, omitted from the paper, which show how help was rendered these individuals. A definite diagnosis having been made, practically normal sight was preserved, and they were able to keep along with their work. I think that it is necessary to have an increase of arterial blood-pressure with this more or less definite suspicion of arteriosclerosis before we are willing to make a definite diagnosis and put them in Group 2. As regards definite changes, the depression of the larger veins by the arteries just above or below the disc is where you are most likely to see alterations. It is easiest to see them there. In the majority of my cases there is just that change. I think there were more of that type of change than of the tortuous terminal twigs which I found practically always near the macula. One example of a change of blood-pressure was a woman in Group 2 who started with high pressure at 180. After seven months' diet treatment she lost 25 pounds in weight, reduced the blood-pressure to 118, and got rid of the headaches. At the end of that treatment she was a much healthier and happier woman than when the family physician and I first saw her.

A CASE OF THROMBOSIS OF THE RETINAL VEIN, WITH REMARKS.

J. HERBERT CLAIBORNE, M.D.,
New York.

On December 26, 1912, a spinster of forty-four years, strong and healthy in every respect, consulted me concerning a big "block" of smoke which appeared suddenly in front of her left eye and particularly toward the nose, in the morning, just after rising; it got a little bit better during the day. I saw her on that date and made the following observations: R. E. normal; L. E. optic disc very red; both upper and lower veins much enlarged, crooked, and blue black; small superficial feathery hemorrhages between disc and macula; no difference in size of pupils, direct reaction in both eyes quite marked, consensual and accommodative sluggish; tension normal; tongue rather thick and slightly gray; patient felt perfectly well in every other respect.

On December 27th a slight hemorrhage on optic disc surrounding the lower vein, filmy in character; condition of optic nerve about the same as yesterday, except the veins are still more enlarged and tortuous; several more hemorrhages of same character in the neighborhood of the macula; a branch of the superior central vein surrounded by a white exudate; field of vision generally blurred and a small islet of scotoma about 20° horizontal, which is about 4 by 4 mm. in size. Ordered examination of urine, which showed indican, a trace, a few squamous epithelial cells, occasional leukocyte; no casts; sugar none; albumen none; reaction acid; specific gravity, 1025.

On December 28th little or no change since yesterday; no increase in hemorrhage; blood pressure 124; pulse 82; Wassermann reaction negative.

On December 31st and January 3d vision in left eye about same as the first examination. Between these two dates a large circular hemorrhage appeared below, involving both

inferior principal veins; optic disc became very much more swollen, giving the appearance of choked disc. Ordered five drops of kalium iodid, t. i. d., notwithstanding the negative Wassermann.

On January 6, 1913, reduced kalium iodid, t. i. d., to three drops; could not stand five. No involvement of any of the collateral sinuses; nothing pathologic in nose or throat. Whole background of the eye has appearance of choked disc. Three days later the heart was examined by a specialist and found to be normal.

January 16th, large hemorrhage below still present, but drying up; increase of the feathery hemorrhages toward the macula and beyond; optic disc still more swollen; several small hemorrhages around the macula noted. V. L. E. $= \frac{2}{4}\frac{3}{0}$, with +.75 D. c. axis 90°.

January 23d, optic disc has the classic appearance of choked disc, intensely swollen; several vessels with the twist of corkscrews on disc and immediately near it; just beyond the macula a number of small round hemorrhages that are not feathery: V. $= \frac{2}{5}\frac{3}{0}$, with correction.

February 3d, condition in all respects about the same as last observation.

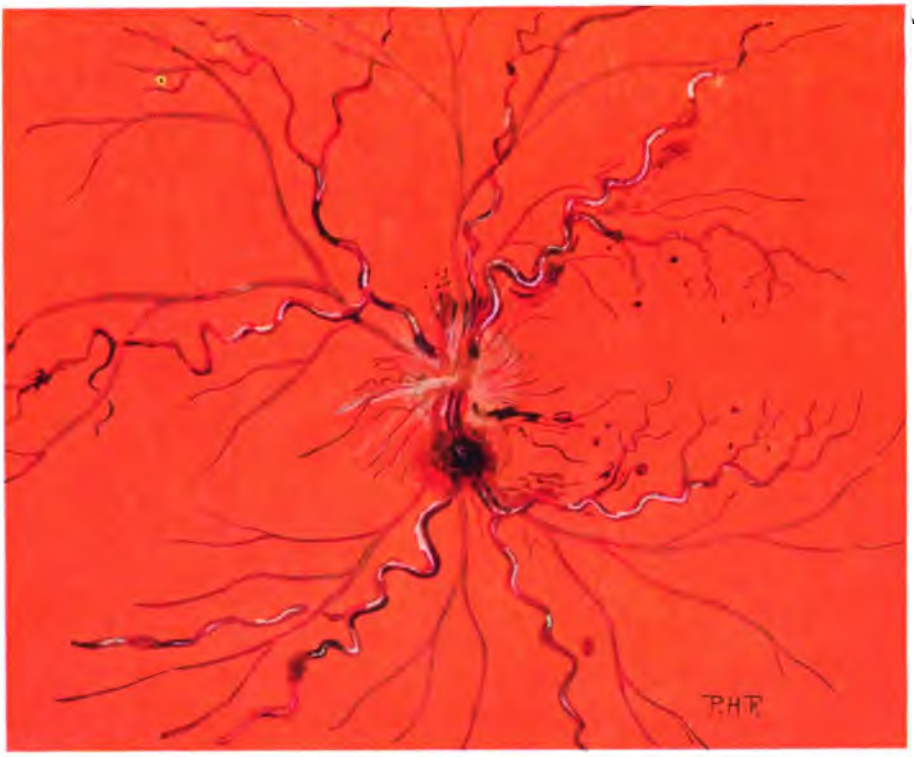
February 14th, fundus commencing to clear up; hemorrhage below much smaller; region between disc and macula clearer; number of the feathery hemorrhages gone; edges of disc clearer though still very blurred; V. $= \frac{2}{5}\frac{3}{0}$ partly.

March 3d, optic disc seen easily; large hemorrhage below still smaller; swelling of veins less pronounced; feathery hemorrhages apparently gone; a few round ones outside of macula still present, but faint. V. $= \frac{2}{5}\frac{3}{0}$, with correction.

March 25th, large hemorrhage below disappeared, but vein dilated where it existed; optic nerve much better but still somewhat blurred; the tightly twisted blood-vessels on the surface of disc still persist; only one feathery hemorrhage beyond disc still observed; V. $= \frac{2}{5}\frac{3}{0}$, partly, with correction.

Drawing of fundus was done by Dr. Percy Fridenberg about January 20th.

Michel was the first to demonstrate anatomically thrombosis of the central retinal vein, and I think it may be said



Thrombosis of retinal vein.

that his investigations and views are entitled to the first place in the study of this subject. He recognizes three degrees of intensity in this condition; to wit, complete obstruction, partial obstruction, and simple stagnation of the current of blood in the vein, and as the corollary to these primary conditions the terminations complete and permanent occlusion, partial and complete restoration, and reestablishment of the permeability of the lumen of the vessel.

The conditions or causes underlying thrombosis of the central vein are, generally speaking, Bright's disease, diabetes, lues, marasmic conditions, erysipelas of the face or nose, and infections involving the facial veins, such as generally cause thrombosis of the cavernous sinus, infections from the collateral sinuses and nose, glaucoma, pernicious anemia, metastasis, as a concomitant of choked disc, and, finally, arteriosclerosis.

Cases have been reported and studied by Michel, Angelucci,—the diagnosis of whose three cases was questionable,—von Zehender, Haab, Goh, Weinbaum, Schnavel, Wagenman, Würdemann, Putscher, Thoma, and others. Thrombosis of the vein is usually situated in one of the central veins of one eye and presents a very striking ophthalmoscopic picture. Goh's case was bilateral and was associated with if not caused by marasmus, but I think the condition in general may be considered unilateral, and in the nature of things would be so, except when it occurs as a concomitant of double choked disc. Heart disease has been assigned as a cause, but for my part I can conceive of that disease being a cause only if we admit that the character of the blood itself is changed; certainly no embolus, however small, can find its way from the heart through the main arteries out to the periphery, be taken up by the capillaries, and produce thrombosis either in a branch or the main vein. An embolism of the artery, partial or complete, would necessarily result from such condition, and the process would be em-

bolic and not thrombotic. Glaucoma has been mentioned as a cause and as a result of embolism, and it is not unreasonable that it might play either rôle. Certainly intense pressure might cause changes in the intima of the retinal veins, and primary thrombosis might cause increased intraocular pressure. We are all familiar with the picture of thrombotic veins in hemorrhagic glaucoma; but who, when such a case is seen for the first time in the stage of active eruption, can tell whether the glaucoma has caused the thrombosis or the thrombosis the glaucoma. By the history of the case alone can such a question be determined? We have to admit that both do exist at the same time, and it is not improbable that each produces its effect upon the other by what is known as the vicious circle.

Leber and Wagenmann have expressed the belief that multiple emboli in the retinal arteries may produce the same ophthalmoscopic picture as thrombosis of the central vein. Haab expresses his agreement with this view, but gives reasons that to me are not convincing. For my part, I unhesitatingly pronounce with the two former observers and even go further.

Looking carefully over the picture illustrating the thrombosis in this case, one cannot help being struck with the likeness to choked disc. The disc is evidently choked, the retina swollen, the hemorrhages numerous; whether they be venous or arterial cannot be exactly determined in some instances. The picture likewise resembles that of complete embolism of the central artery. The absence of the red cherry spot at the macula, however, saves the diagnosis.

In this case the choking of the disc is late; whereas in pure choked disc the choking takes place first and the thrombotic and embolic processes come later. Time is certainly an element in the differential diagnosis. Haab remarks also that albuminuric retinitis presents a very similar process, which no one can doubt, and this leads me to the thought

I desire to present that pure thrombosis can be diagnosed solely when the case is seen and studied from its very incipiency. In short, the thrombosis may be a symptom or a concomitant of certain well-known processes. Of course, thorough examination of the patient must be made, and by this means the cause will usually be found among those cited.

This case, however, makes an exception to the rule. As will be remembered, there was no albumen, no sugar, no casts; in short, no disturbance whatever of the kidneys nor any other general disorder. The first examination of the urine was made December 27, 1912, and there was found a trace of indican. The second, made January 28, 1913, showed a moderate amount of indican. This phenomenon points to the intestine and not the kidneys, but has in my opinion little significance.

I think it can be said in general that in order that a thrombosis may exist in a vein, there must be postulated a solution in continuity in the intima of the vessel, and I venture to suggest that from whatever underlying causes it may arise, there is first a rupture in the lining of the intima. These ruptured cells then project into the lumen of the canal, much as an obstruction of any sort would in a stream of water, and, by virtue of the obstruction, fibrin is deposited by degrees on the projected cells, is accumulated constantly, the endothelium is ripped up by the blood current, the underlying layers of the vessel become disorganized, and hemorrhage ultimately takes place. I believe that arteriosclerosis in greater or less degree lies at the bottom of the phenomenon. This would certainly be consistent with all the causes that have been heretofore mentioned.

Possibly some local degeneration of the intima of the vessel was present in this case and was the cause of the condition, unless time shows that there existed some hidden grave constitutional disorder. I believe the cause in this case can be attributed to this weakness of the intima. It is ques-

tionable whether this might be called an arteriosclerosis; perhaps it was a localized one. I see no reason why such a thing should not exist. When once the process had become well established in one central vein, the opening through which the vein passed into the cribriform lamina became blocked, there was damming up of the blood in the entire venous current, and consequent swelling of the optic nerve. It will be noted that the arteries are not very small in this case, and never were throughout its whole course; but this fact may be explained on the ground that the aperture of the cribriform membrane through which the vessels passed was only partially blocked by the contiguous swollen veins and the general exudation. When the nerve-head becomes more swollen, the arteries naturally get smaller by reason of the increased pressure, and I believe this is the explanation in general for the presence of small arteries in venous thrombosis of the retina.

White areas of degeneration have been mentioned as occurring in the retina in thrombosis, particularly in that form produced by albuminuria, but only one was observed here and that disappeared with the process of absorption. It appeared at all times to me to be a fresh exudation of fibrin. Since there were numerous hemorrhages, and one very large one in particular, and since there were no white degenerative areas, I am led to hold the view of Haab on this point that the white areas are not due to hemorrhages but to something else, probably a disturbance in the nutrition of the retinal elements or an abnormal condition of the blood itself.

Though I have seen a number of cases of thrombosis of the retinal veins, I have only studied three of them carefully, and this last one with greater care and for a longer time than any of the others. My first case was published in the *Ophthalmic Record* a number of years ago.

The thrombus occurred in a large, fat, short-necked

Jewish woman who became suddenly and totally blind in one eye. Finally, she recovered a small eyelet of central vision, corresponding to the position of the macula lutea, whereas the rest of the field was absolutely and totally blind. Interest in this case lay in the fact that one lower vein alone was affected; about three or four mm. from the edge of the disc it suddenly commenced to swell into a sacculated shape, looking like a small sausage about 4 mm. in length, was blue black, and seemed on the point of bursting, but it never did. There was a general moderate venous congestion, but other than this no changes whatsoever. The venous thrombosis ultimately disappeared, but the field remained the same throughout the time of my observation, which was about a year. I always thought there must have been some pressure behind the globe. I am unable to find the record of this case, and therefore can make no statement concerning the general condition of the patient.

The second case was one of partial thrombosis. I have a number of times seen this condition, but it has generally occurred near the disc in a comparatively large vein. The thrombosis in this case occurred in a young man of twenty-seven who noticed a gradual blurring of the vision of his left eye. He had obtained several opinions as to the cause, but there was a difference in diagnosis. I discovered, upward and outward, almost at the periphery of the retina, a well-marked thrombosis or swollen vein. There was a moderate sacculation of the vessel, commencing more or less gradually, and decreasing gradually. Just beyond the sacculated portion the vein was thin and indistinct. A slight degree of exudate but no hemorrhage surrounded the sacculated portion. A scotoma, located by the perimeter, corresponded with the thrombosis.

I have never seen any other case like these two, and I think they are both worthy of record. I lost touch with this young man also, as he took the matter into his own hands.

I remember distinctly that his urine was normal and that he was in general good health. The Wassermann test had not been discovered at that time, but he denied lues. It would interest me to know if any one else has seen such cases as these two.

I have already stated that the literature on this subject is not abundant, and the text-books devote but little space to it. I fancy this may be because the condition is generally associated with some other intraocular change and general disorders.

The one herein described appears to me unique in literature by reason of the absolutely perfect general health of the patient. It is hoped that greater interest may be awakened in this subject, so that the study of these cases in the future may be more thorough.

DISCUSSION.

DR. ALLEN GREENWOOD, Boston: I simply want to call the attention of the Society to the occurrence, which Dr. Claiborne pointed out in these cases, of a secondary glaucoma due to the interference with the venous flow. I think that a certain number of these cases of central vein thrombosis are afterward, from a few months to a year or so, apt to develop a posterior glaucoma, uninfluenced by eserin, pilocarpin, or iridectomy, and require enucleation. The late Dr. Wadsworth sent a patient to me who had a glaucoma resulting from a previous thrombosis of the central vein. He told this patient that pilocarpin and operation in the way of an iridectomy would probably do him no good, and advised that the eye be enucleated, which advice I followed. I have had three cases in my practice of glaucoma following a thrombosis of the central vein, and removal of the eyes was required, as the ordinary treatment of glaucoma proved unavailing, as is the rule in such cases.

DR. ALBERT C. SNELL, Rochester, N. Y.: The remarks of the last speaker lead me to report a case of thrombosis of the central vein which Dr. Rider had under his care, having been seen by me in the early stage of the phlebitis. The

case apparently originated from an abscess of a tooth which infected the sinus, causing a typical picture of retinal endophlebitis. Then followed later a typical hemorrhagic glaucoma, and while he was under my care I advised, as the only thing to do, the removal of the eye. He was a prominent lawyer, and desired to save the eye if possible. Dr. Rider did an iridencleisis, obtaining a cystoid cicatrix. The patient still has his eyeball after three years, illustrating that it is not always absolutely necessary to enucleate in these cases.

DR. WILLIAM ZENTMAYER, Philadelphia: I wish to put on record a case of thrombosis of the central vein in which operative measures saved the eye. A woman with thrombosis of the central vein with only light perception developed secondary glaucoma. Cyclodialysis was the operation of choice because it was desirable that the tension should not be suddenly diminished. Tension was reduced by the operation, but after the lapse of a year again became somewhat increased, and I then did an iridectomy successfully. It is now about two years since the latter operation, and she has an eye with good tension and light perception, which is much better than an empty socket.

ONE MORE WORD ON TEST-CARDS AND TYPE.

B. ALEX. RANDALL, M.A., M.D.,
Philadelphia.

Test-card construction has always greatly interested me since, thirty-two years ago, at Dr. Risley's suggestion, I made my first set based on the admirable type of Dr. John Green. The recurring publication ever since of caricatures of Snellen's type has kept me keenly alive to the shortcomings of many of those in use; while the writings of some would-be experts on the subject have shown how inadequately many have grasped even Snellen's faulty

principle. In his chapter on "Methods of Determining the Acuity of Vision" in Norris and Oliver's System, Snellen implies the acceptance of the cardinal principle enunciated by Hooke in 1705, that the measure of the "minimum visible" is *the interspace* between the two objects to be distinguished; but, having assumed its virtual realization in his Roman block-letter inscribed in a square subtending at the chosen distance an angle of 5 minutes, he lays stress—as have most imitators—on the 1′ strokes of the 5′ letter—often in total contravention of the law as to interspaces.*

Much as we owe to Green for his valuable contributions to this matter, it is unfortunate that so many have followed the mistake embodied in his Gothic letters, as published in our "Transactions" in 1868; for they too greatly simplify the test, fail to furnish the expanded ends, which, as Giraud-Teulon pointed out, offset irradiation and offer interspaces which are rarely of the standard 1′ dimension. His improved type, as given in his American edition of Carter "On the Eye," in 1876, has never been equaled in meeting the actual needs of the case, but has been employed in few of the publications. Its half-block addenda to the extremities of the letters meet the scientific needs, while forming shapely, unexaggerated type, and permit the use of most of the alphabet. Snellen early appreciated that many letters lent themselves poorly, if at all, to his purposes; and he sadly distorted some of the already ungainly letters of his type to make them at all admissible. When he spread the A and H to 7′ breadth to obtain room for their exaggerated feet, he generally violated his own basal principle. Others barred out many letters—Oliver, 19; although even of the 7 which he retained 3 do not exemplify the 1 minute interspace except so far as the un-

*"The letters and figures were made square. The lines and interspaces as far as possible were alike, and amounted to one-fifth of the height of the letters. In calculating the size, the arc and not the tangent was taken."

broken circle O is to be distinguished from the broken circle which does duty for a C. Those who employed Green's simple letters found many of them, even when narrowed into more conventional shape, too easy tests for the distances stated, especially when measured in English feet instead of the Paris feet for which they were calculated. Therefore, Wallace empirically cut them to subtend an angle of 4′, while Dennett allowed for the unequal legibility of various letters of the same dimensions, and gave us a card of many-sized type equally legible in his experiments.

Most of this difficulty disappears when using the improved letter of John Green, with their half-block addenda, although S and B, and W and M, are rather too difficult, and I, J, L, and O too easy, except as confusion-letters to be distinguished from those better chosen. This point of barely distinguishable similarity has much practical value, as in distinguishing U, V, Y and T, or G, C, O, and D; while the too easy examples, like L, serve to start the patient right on the line he is trying to decipher, and thus correctly indicating it to the examiner. Burchardt's letters may afford us the adequate expansion of the ends to lessen their blurring by irradiation, but do not in any other respect commend themselves. Most German and other type still less meet the needs of the determinations.

The general use of metric measurements has relieved some of the confusion growing out of the earlier use of the Paris inch and foot, but discrepancies from this cause are still seen, and I have felt it better to specify all three standards on most of the cards which I have published. It is also curious that Snellen, who began by taking his measurements from the arc of the visual angle, should later have adopted the tangent of the visual angle of 5′ as his standard height instead of twice the tangent of half the angle. In this small error almost all makers of test-cards have followed him, using the multiple 0.001454 instead of 0.001425,

and giving the LX letters a height of 87.24 mm. instead of 85.5. Such letters subtend a 5′ visual angle at 61.22 meters; so a constant error of 2 per cent. is introduced, which may compensate for the frequent faulty execution of the published card, yet is inadmissible in what should be accurate standards. As before noted, many of the tests have been drawn for 200 Paris feet, and, when given a height of nearly 95 mm., should be legible at 223 English feet; while those printed on paper generally underwent distortion and stretching, further vitiating their reliability. Printed upon heavy cardboard, as is now the rule, the intended dimensions have been fairly retained, but these have been too rarely computed correctly. Giraud-Teulon and Galezowski used a computation of their own, giving letters of a height only $\frac{1}{1000}$ of the distance instead of about $\frac{1}{700}$. Galezowski's XXX type are quite accurately XX.

Since irradiation was long since shown by Giraud-Teulon to be a disturbing factor, it might have been supposed that means would have been taken, in addition to broadening the extremities of the letters, for avoiding this defect in our type. I believe I stand almost alone in advocating a cream or even India-tint cardboard as the basis of our charts. Of course, many have used the white tests on black ground, such as Galezowski gave us in 1880; but these avail little, if at all, in this respect, although perhaps less fatiguing to the eye. Even a lemon or orange ground is almost as luminous as white, and under many conditions of i lumination preferable. Without always realizing why, most experienced refraction-workers prefer their time-stained cards to new ones.

As to the whole genus of tests for illiterates, empiricism generally dominates. The "Haken" of Snellen, or the E-shaped tests of Cohn, like the groups of parallel lines, may be turned in all directions, and if given strokes and interspaces of 1′ visual angle, may constitute easy yet

scientific tests. Too generally Snellen's square subtending a visual angle of 5′ has been accepted as an unassailably scientific basis, and any figure, solid or discontinuous, that could be crowded into its limits or only partially overlapped them has been offered as a test. The frequent use of 1′ strokes, and the rarity of 1′ interspaces, only serve to prove that little or no real effort at empirical standardization has been made. Semaphore figures for railway employes may conform to their prejudices as to how they should be examined, but I have yet to see any adequate tests of the sort.

Snellen offered sets of dots inscribed in the 1′ divisions of his 5′ square, and only later perceived that they were far astray as to their dimensions. Norris, in the 70's, taught his assistants to use the L dots of Snellen as a fair test for normal vision at 20 feet; and Burchardt worked out experimentally a similar ratio—a visual angle of 2.15′ for dots and interspaces. All admit that there is a mental as well as a visual act required to count dots or name object-outline, which is almost absent in the half-automatic recognition of letters by reading patients, so that parallelism is almost impossible. The Arabic numerals have almost equal automatic acceptance among all peoples, and are familiar to many who do not read letters, yet they lend themselves very imperfectly to any standard proportions of strokes and interspaces, and have been almost invariably accepted solely as having a 5-minute height.

DISCUSSION.

DR. WILLIAM ZENTMAYER, Philadelphia: I think test-cards should be viewed from two standpoints, first, as to their adaptability for testing for glasses, and, second, for the determination of visual acuity. The card which may be well adapted for the first purpose may be faulty for the second. Dr. Randall emphasizes the fact that not only should the strokes, but also the spaces in the letters, subtend a one-minute angle, yet in his own card he has included

such letters as A and Y, which do not fulfil this requirement, because there is a diminishing size to the angle of the white space included in the fork of the strokes, and some portions of it subtend more and others less than one minute. I should exclude such letters from a card for the scientific determination of visual acuity, but consider them to be of the greatest value on a card used in testing for glasses, as they constitute a group of confusion letters. I consider that Landolt's optotypes meet the requirements of a scientific test for visual acuity, but they are of little value in testing for refraction errors.

DR. B. ALEXANDER RANDALL, Philadelphia: Dr. Zentmayer is correct. This converging portion of the letter does not offer a one-minute interspace throughout, but as meeting a partly psychic recognition of the letter it is permissible, not as an absolute test of visual acuity. I have referred to that in my paper, but have not cut down the letters to only five or six letters, which have precisely the one-minute interspace, as in these simplified tests Dr. Jackson has offered us. I was mean enough to have meant to use Jackson's test as a horrible example in one respect—that he has printed it upon a perfectly snow-white, glossy card, and because of irradiation you will find the one-minute space there is not a satisfactory test, even when as accurately worked out as it has been by Dr. Jackson.

ON THE FATIGUE OF CONVERGENCE AND ITS VARIETIES.

LUCIEN HOWE, M.D.,
Buffalo, N. Y.

At the meeting of the American Medical Association in 1912 a description was given of the ergograph with an attachment of revolving prisms, and it was shown that with this arrangement different groups of the recti muscles could be made to write their own stories of the development and increase of fatigue. For example, in measuring the fatigue of convergence, the patient looks through a revolving prism of Crete or Risley, placed base out, and the effort required to overcome a given prism is indicated by a pen-pointer, which traces its way over the paper on the revolving cylinder of the ergograph. Repeated efforts to overcome the prisms produce fatigue, and that is shown by a decreasing ability to converge and by a corresponding decrease of the excursion made by the pen-pointer on the revolving drum. A sample of such a tracing is shown in Fig. 2.*

In that first preliminary and necessarily condensed communication, what might be called "normal" fatigue was mentioned, and two variations from the normal then designated as the "abnormally strong" and the "abnormally weak" types.

During the last year a considerable number of other

* In this and the following illustrations the lowest horizontal line indicates that the two revolving prisms neutralize each other. The second horizontal line is at the point where the revolving prisms correspond to a single prism of ten degrees base out, the third to a prism of 20 degrees base out, and the fourth to a prism of 30 degrees base out.

tracings have been made by practically normal eyes, and also by the eyes of patients presenting different pathologic conditions. When these later tracings were compared with

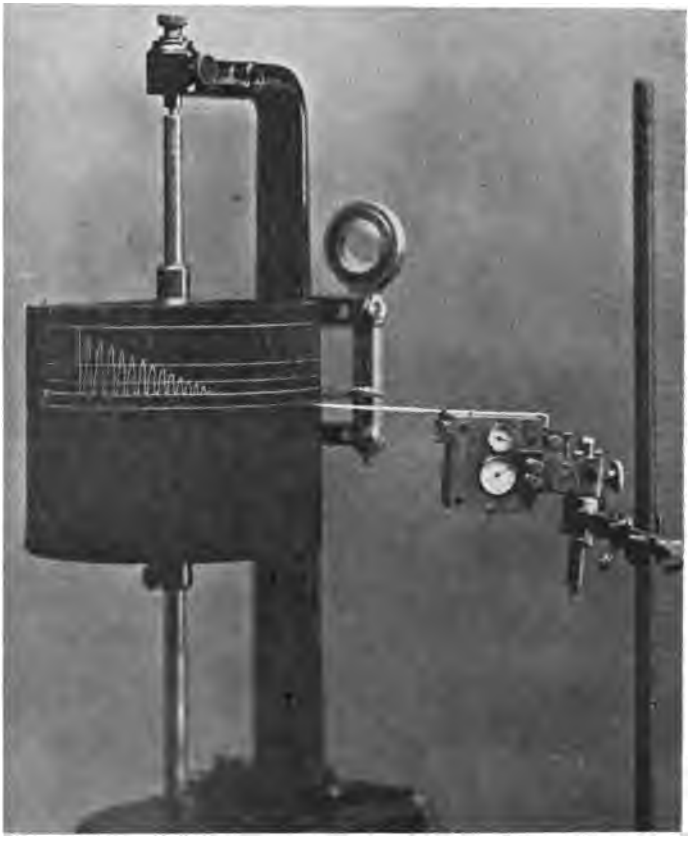


Fig. 1.—The first form of the ophthalmic ergograph.

each other, and with others previously made, it seemed possible to obtain a more exact idea as to what we might consider "normal" fatigue, and as to the two varieties of the abnormal types already mentioned.

We are, therefore, prepared to approach the subject one step nearer. The objects of this paper are:

(1) To define what we should understand by "fatigue" of any muscle in any part of the body. (2) To establish some standard, at least approximately, by which to measure the normal fatigue of convergence as that is shown by the ergograph, and otherwise. (3) To show not only what are the two groups of variations from the normal type of fatigue, but to call attention to the existence of two subdivisions of each group.

We will consider very briefly each of these points in order:

First, as to our definition of the word "fatigue." As much of our confusion of ideas, especially in regard to the ocular muscles, is due to confusion of terms, it is desirable to agree on a definition, not only of the word "fatigue" when applied to any muscle, but also of the "normal fatigue" of the muscles of convergence.

It seems proper, therefore, to define the noun "fatigue" as the *process* of becoming fatigued or tired when a muscle, which has been at rest, is contracted repeatedly with more or less gradually decreasing power.

On the other hand, we should use the participle "fatigued" and *not* fatigue to express the *condition*, at any given time, of a muscle which has been already thus repeatedly contracted. Although this distinction seems so self-evident, it is unfortunately often disregarded even in some of the best works on physiology.

When the fatigue of any muscle is traced by the pen on the revolving drum of the ergograph, it is evident that two factors are represented. One of these is the *strength* of each muscular contraction shown by the vertical excursion of the pen, and the other is the *time* shown by the horizontal distance traced on the drum. If the tips of the vertical excursions made by the pen be joined by a line, we have the "fatigue curve" of the muscle, whichever it may be.

Second: The normal fatigue of convergence we would naturally understand as the fatigue ordinarily shown by a pair of practically normal eyes belonging to a practically healthy individual.

In this the word "practically" means that any esophoria present does not exceed two degrees, nor exophoria one degree, nor ametropia 0.75. Of course it is understood that the accommodation is at rest, the test light being at least six meters distant. A "practically" healthy individual means that the general strength is at least equal to the average, as shown approximately by the hand-dynamometer, or

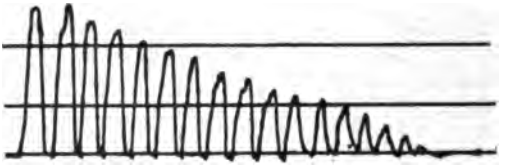


Fig. 2.—Average tracing of the fatigue of convergence in a pair of normal eyes.

as expressed more exactly in foot-pounds by the Sargent tests.

If now we keep in mind these restrictions, and then select accordingly the ergographic tracings made by such eyes, we find a striking resemblance to each other. They warrant the conclusion that the "normal fatigue of convergence" is that in which the initial contraction is sufficient to overcome a prism of about 10 to 15 degrees, and in which the contractions then tend to decrease more or less gradually during about 10 to 18 efforts to exhaustion or to the point nearest to exhaustion. (See Fig. 2.)

It will be noticed that in this definition no special limit is given to the amount of the first contraction. We now know that the ability to overcome prisms of gradually increasing

strength is not constant, ranging from 6 or 8 to 12, 15, or often more. A more important factor apparently is that of time—that is to say, whether the group of muscles does or does not "run down" during about 10 to 15 or 18 contractions.

In this definition no mention is made of the *treppe*,—of the ability to make unusually strong contractions which sometimes recurs at intervals,—that being an abnormal variety of fatigue to be referred to in a later study.

Third: The varieties of fatigue of convergence. With this understanding of what is even approximately the normal fatigue of convergence, we are better prepared to

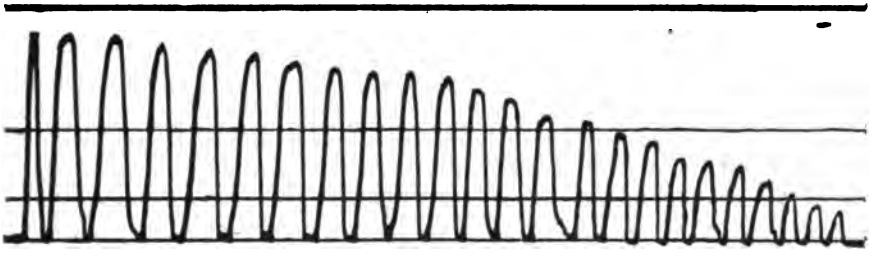


Fig. 3.—Abnormally strong initial contraction with abnormally slow development of fatigue. (See foot-note, p. 569.)

arrange the varieties which seem more or less abnormal. In this, of course, we have to do with the same two factors of the strength of the contractions and the time required for the muscle to run down.

Thus we have (A) the strong group:

1. An abnormally *strong* initial contraction with abnormally *slow* development of fatigue (Fig. 3). It is understood that the rate of this decrease in strength is slower than for normal eyes—that is, extreme fatigue (or the lowest point of the tracings) is not reached after 10 to 18 contractions.

2. An abnormally *strong* initial contraction with abnor-

mally *rapid* development of fatigue (Fig. 4). Even if this decrease is about the same as for a pair of normal eyes, that

Fig. 4.—Abnormally strong initial contraction with abnormally rapid development of fatigue. (See foot-note p. 569.)

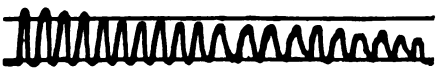


Fig. 5.—Abnormally weak initial contraction with abnormally slow development of fatigue. (See foot-note p. 569.)

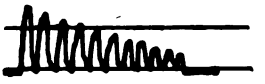


Fig. 6.—Abnormally weak initial contraction with abnormally rapid development of fatigue. (See foot-note p. 569.)

is, if extreme fatigue is reached after 10 to 18 contractions, that rate of the development of fatigue may be abnormally

rapid in relation to the abnormally strong initial contraction.

Again we have (B) the weak group:

3. An abnormally weak initial contraction with an abnormally *slow* development of fatigue (Fig. 5).

4. An abnormally weak initial contraction with an abnormally *rapid* development of fatigue (Fig. 6).

Each of these groups is of sufficient clinical importance to be considered later in a separate communication.

It should be understood that each tracing does not belong unquestionably and distinctly to some one of these four varieties. Every now and then we obtain a tracing which resembles partly one variety and partly another. They seem to blend the different varieties. But such tracings are exceptional. They can be easily described by a compound term indicating their nature, and can also be considered by themselves.

The more carefully one studies these four types of fatigue, if they are taken in connection with other pathologic findings, the more significant do the tracings with the ergograph appear.

Any one such tracing by itself has comparatively little meaning. As a deviation of the globe from its normal position, or what we call "strabismus," is in itself nothing more than a symptom of a pathologic condition of the muscles or of the nerve supply to them, so in a similar way an ergographic tracing of an abnormal fatigue of convergence is valuable principally for the evidence which it furnishes of the condition of the muscles themselves or of the nerve supply to them. But, as an anomaly of convergence is, as far as measurements show, quite as important a factor as is an anomaly of accommodation in the production of what we call "eye-strain," so is a record of the fatigue of convergence written by the muscles themselves of special interest to the practitioner.

It can therefore be said without fear of exaggeration that the ophthalmic ergograph gives us promptly more accurate and more complete data concerning the development of fatigue, especially the fatigue of convergence, than can be obtained in any other way.

TRANSACTIONS

of the

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Fiftieth Annual Meeting

HOT SPRINGS, VA., 1914

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1914

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Dr. John Green.

NECROLOGY.

DR. JOHN GREEN.

A. E. EWING, M.D.,
St. Louis, Mo.

Amid the brilliant galaxy of great ophthalmologists and physicists of the last century who elevated ophthalmology to its rightful place in medicine, one of the most notable characters is that of John Green. Born and reared amid the rugged hills of Massachusetts, he possessed a steadfastness of nature during the whole course of his long and useful career which evidenced the strong influence of this early environment. Also, he was almost by inheritance a physician, being the fifth in a succession of physicians in the family during a period of a hundred and thirty-five years. In like manner might we account for a certain pioneer tendency shown in his love of investigation and the spirit of adventure which influenced him to take up his abode in the then far west and establish himself in a region where pure ophthalmology was practically unknown. Born to the highest motives only, time and circumstance wrought no influence to lower his standards. Association with the great masters in ophthalmology, such as Bowman, Donders and Snellen, and the cultivation and inspiration that naturally ensue to a capable, receptive mind, engendered in him an enthusiasm for ophthalmology that induced him to choose this branch of medicine with an intelligent conception of its inherent dignity and of its vast importance to mankind. This he once tersely expressed in the answer to an inquiry as to why he adhered so closely to the American Ophthalmological Society, that "It is composed of men

interested in ophthalmology to the exclusion of personal aggrandizement."

Dr. Green was born April 2, 1835, at Worcester, Mass., being the son of James Green, of Worcester, and Elizabeth (Swett) Green, of Dedham, Mass., and he came of an ancestry distinguished in the history of New England, being third in descent from Dr. John Green, who was a member of the Massachusetts General Court, 1777. Also he was the eighth in descent from Thomas Dudley, second governor of Massachusetts Bay Colony, the seventh in descent from Jonathan Sprague, who served in King Philip's war, and the fourth in descent from Judge Timothy Ruggles, Brigadier-General, president of the Stamp Act Congress. He represented the fifth generation of physicians bearing the name of Green in the County of Worcester. However, this ancestral honor was never a subject for discussion in the family. In fact, I never heard it mentioned but once during an intimate acquaintance of thirty-two years. This was by a guest one evening at dinner, and the Doctor's repartee was that to his best recollection somewhere along the line someone had been hanged for witchcraft. Yet his interest in the spirit of national patriotism was shown in his being a Founder of the Society of the Sons of the Revolution, and a Founder and Deputy Governor of the Society of Colonial Wars in the State of Missouri.

In 1868 he married Harriet Louise Jones, of Templeton, Mass., who survives him, together with a son, Dr. John Green, Jr., and a daughter, Elizabeth Green.

His college preparation was obtained at the Worcester Classical and English High School. In 1851 he entered Harvard, and was graduated from there A.B., 1855, S.B., 1856, A.M., 1859, M.D., 1866. In 1857 he accompanied Prof. Jeffries Wyman on a scientific expedition to Surinam, Dutch Guiana, as Curator of Comparative Anatomy of the Boston Society of Natural History. Also, during his med-

ical studies at Harvard he formed the firmest relations of friendship with Prof. Louis Agassiz and Dr. Asa Gray.

He really completed his medical course at Harvard in 1858, but refused to accept the degree because he considered the course unworthy of the institution. However, he was admitted a Fellow of the Massachusetts Medical Society by examination in 1858, and passed the following two years in the study of medicine in London, Paris, Berlin and Vienna. In 1861 he entered the practice of medicine in Boston, filling the positions of Attending Physician and Surgeon to the Boston Dispensary and of Recording Secretary to the Suffolk District Medical Society. In 1862 he entered the service of the Western Sanitary Commission, and served as Acting Assistant Surgeon, U. S. A., in the armies of the Tennessee after the battle of Pittsburg Landing, and at Frederick City, Md., after the battle of Antietam.

He was a member of the Boston Society of Natural History and of its Council, of the Boston Medical Association and of the Boston Society for Medical Observation, and a delegate to the American Medical Association, 1864 and 1865. In 1865 he again visited Europe for special study in ophthalmology, principally in London, Utrecht and Paris. In 1866, by reason of the reforms that had been accomplished in the Harvard Medical course, he accepted his medical diploma and established himself in the practice of otology and ophthalmology in St. Louis. Twenty years later he devoted his entire time to ophthalmology.

In the city of his adoption he has been an uncompromising leader in the elevation of the standard of medical education and a great power in the creation of the present high standard that obtains in Washington University, to which he was chosen a lecturer on ophthalmology in 1871, it then being the St. Louis Medical College. In 1886 he was advanced to the professorship, which position he occupied until 1899, and from then until 1911 the chair of Special

Professor in Ophthalmology. On his withdrawal from active service he was honored by the institution as Professor Emeritus. Also in further recognition of his literary attainments and of his valuable services in its behalf, Washington University conferred upon him the honorary title of LL.D., and the same honor was accorded him by the University of Missouri.

For more than thirty years he was connected with the staff of St. Luke's Hospital, originally conducting a clinic in its out-patient department, until this department was abandoned for lack of space. This clinic was then combined with that of the O'Fallon Dispensary, Medical Department of Washington University, which was founded under his direction in 1882, and was practically under his charge until his death. Since the founding of the institution he has also been Consulting Ophthalmic Surgeon to the Barnard Free Skin and Cancer Hospital. He was also a charter member of the St. Louis Ophthalmological Society. In the earlier days of his practice he was Consulting Ophthalmic Surgeon to the St. Louis City Hospital, and for many years was one of the main supporters of the German Evangelical Hospital.

In the arts and in architecture he was a connoisseur. In educational and scientific circles he was a recognized leader and profoundly esteemed for his erudition in all matters pertaining to science, to the ancient languages, and to archeology, being a charter member of the St. Louis Archeological Society. For many years he was president of the Harvard Club in St. Louis, and for many years president of the Academy of Science. Through the latter office, being ex-officio member of the Directorate of the Missouri Botanical Garden, because of the wisdom of his counsel, he was later appointed as a permanent director on its Board.

In ophthalmology his work is too well known to the members of the Society and to the ophthalmic world in general to need extended recapitulation. The articles themselves may

be referred to through the appended bibliography. He originated the best subjective tests for astigmatism extant, the most perfect ratios for the gradation of optotypes, the most scientific method of mounting test lenses, one of the best solutions of atropin and atropin and cocain, one of the best methods of treating the lacrimal duct, a valuable improvement in orbital evisceration, and one of the best and the most humane of the many operations for entropion.

In his professional relations with his patients he was very exacting, particularly as to their own care of their afflictions, and he was severely austere whenever there was any tendency to neglect. The financial consideration was always a wholly negligible factor. Naturally of a modest, retiring disposition, he possessed an inestimable refinement of thought and language that charmed and convinced. His vast fund of accurate knowledge was accompanied by a keen sense of humor that found endless pertinent application.

The day previous to his final illness he left his office with the remark that he was not feeling very well. The following morning his intimate friend, Dr. W. E. Fischel, discovered that he was suffering with pneumonia. Eight days later marked his passing, the seventh of December, 1913, a fitting period in the year for the closing of a life so noble, a service so long and so replete with benefit to his fellowman.

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DR. DAVID COGGIN.

JAMES A. SPALDING, M.D.,

Portland, Maine.

Dr. David Coggin, a member of this Society, died May 7, 1913, after an illness of several months, the result of cerebral disease which first revealed itself years before as bilateral hemianopsia.

Dr. Coggin was born in West Hampton, Massachusetts, August 4, 1843, the son of Rev. David Coggin and Ella (Kidder) Coggin, but losing his parents at an early age he was taken by relatives to Lowell, Massachusetts, where he was educated in the public schools. He began the study of medicine with Dr. Savory, of Lowell, in 1865, and also attended a first course of lectures at the Harvard Medical School. In the following year he went abroad, where among other celebrities he met Sir James Simpson, who in his presence showed Gosselin how to utilize acupuncture, then very much in vogue. After his return, Dr. Coggin studied at the Long Island Hospital Medical School, and finally obtained his degree from the Harvard Medical School in 1868.

In memory of his father, who was a Dartmouth graduate of 1835, Dr. Coggin received from that college the honorary degree of A.M. in 1878.

He practised a while at Lowell and at Hingham, but finding country practice too wearisome he removed to St. Louis, where he made the acquaintance of Dr. John Green, was his assistant in the eye and ear hospital, became a member of the State Medical Society, and contributed to the St. Louis *Medical and Surgical Review* a number of excellent papers. But wearying of the West he returned to Massachusetts, settled at Salem for a while, and then went abroad to prepare himself to be an ophthalmic and aural surgeon.

Dr. David Coggin

After his return, the rest of his life was devoted to these specialties. He early advocated a cottage hospital, and when it was finished he was appointed ophthalmic and aural surgeon.

Dr. Coggin abandoned otology in 1895 but continued in ophthalmology the remainder of his life, and not only enjoyed an excellent practice but communicated to the profession the results of his labors. For more than thirty years he wrote brief "Notes of Cases" to the Boston *Medical and Surgical Journal*—items of everyday practice, atropine, astigmatism, iritis, glaucoma, trachoma, and new remedies.

He was also an editor of the *American Journal of Ophthalmology*, and wrote for its columns papers on glioma and nosology. For Dr. Knapp's *Archives* he wrote on evulsion of the eyes, and on exophthalmos. To this Society, to which, at the initiative of Dr. John Green, he was elected in 1875, he contributed papers on accommodation and on other topics. Taking all in all, he wrote as many as sixty meritorious papers on ophthalmology in the course of his career.

No account of Dr. Coggin's life would be complete without emphasizing his famous suggestion for the detection of alleged unilateral deafness by means of the binaural stethoscope, as presented by him to the American Otological Society in 1879.

Late in 1890 he suffered from an attack of hemianopsia, and, as he read, unknown to his hearers, a report of his own case before the Essex District Medical Society, a branch of the Massachusetts Medical Society, of which he was a member, I will relate it briefly, as part of his life and as the beginning of the end:

November 8, 1890, he was called into the country, and came home late without having had any chance for lunch. He had observed before that if he had no food at noon, he

would suffer from headache and a "fortification scotoma," and was therefore usually careful to eat at noon. This time it was impossible, and on reaching home he complained of headache, and it was noticed that his right eye turned in. He lay down, and was soon found unconscious and breathing stertorously. During his recovery he diagnosticated a bilateral homonymous hemianopsia, which remained for life, although central and color vision were preserved. The area of blindness gradually diminished, more in the right than in the left eye.

On August 7, 1911, he was affected with right hemiplegia, from which he never recovered. Several months before his death intense pain set in and persisted to the end.

After the hemianopsic attack, Dr. Coggin resigned his hospital position and practice, but as he improved he began with them all over again, and kept on until his last attack. He spent a good deal of the time during the last of his life in annotating and arranging his cases and operations, and in recovering and arranging chronologically all of the medical papers which he had written.

Dr. Coggin was a very genial, conversational man, an excellent adviser in his specialties, and an expert operator.

In 1880, at Jamaica Plains, Massachusetts, he married Miss Elizabeth Eames Williams, daughter of Jeremiah and Emmeline Childs Williams, and she with her four children survive our former associate.

MINUTES OF THE PROCEEDINGS.

FIFTIETH ANNUAL MEETING.

THE HOMESTEAD,
Hot Springs, Va., May 12, 1914.

The Fiftieth Annual Meeting of the Society was called to order at 9.45 A. M. by the President, Dr. Robert Sattler.

The President announced the appointment of the following Committee:

On Time and Place of Meeting.—DRS. GEORGE F. LIBBY, ALLEN GREENWOOD, and G. E. DE SCHWEINITZ.

The following papers were read and discussed:

1. "A new operation for the removal of true and false pterygium, and for other growths at the sclerocorneal junction," Dr. Charles H. Beard.

2. "A new operation for capsulo-muscular advancement, combined with partial resection," Dr. S. Lewis Ziegler.

Discussed by Drs. Weeks, Howe, Wilder, Beard, and Ziegler.

3. "Sclerocorneal trephining for glaucoma. Complications and failures in one hundred cases," Dr. Alex. Quackenboss.

4. "Trephine operation for glaucoma. Late infection from an acute conjunctivitis," Dr. Myles Standish.

Papers of Drs. Quackenboss and Standish discussed by Drs. de Schweinitz, Greenwood, Howe, Pyle, Ziegler, Pusey, Weeks, Ellett, Theobald, Ray, Lancaster, Parker, Wilder, Randolph, Lamb, Dodd, Quackenboss, and Standish.

5. "Report of a case of detachment of the retina occurring in a case of neuroretinitis, relieved by scleral trephining

operation, associated with incision of the choroid and retina. No recurrence after a period of eight months," Dr. Walter R. Parker.

Discussed by Dr. Zentmayer.

6. "Report of a series of extractions of cataract in the capsule after subluxation with the capsule forceps," Dr. Arnold Knapp.

Discussed by Drs. Timberman, Weeks, Clark, and Knapp.

7. "Preliminary capsulotomy in the operation for the extraction of immature cataract," Drs. Howard F. Hansell and C. E. G. Shannon.

Discussed by Drs. Pyle, Woods, Greenwood, Ziegler, and Shannon.

The President announced that Dr. H. L. Hilgartner was invited to sit with the Society and take part in its discussions.

AFTERNOON SESSION, MAY 12TH.

Exhibition of New Instruments and Apparatus.

Dr. S. Lewis Ziegler exhibited a new double-disc ophthalmoscope, with independent driving gears and improved electric-light attachment.

The reading of papers was resumed.

8. "Cranial deformity associated with ocular changes." Exhibition of stereoscopic Roentgen-ray plates. Dr. T. B. Holloway.

Discussed by Drs. Lamb and Holloway.

9. "Melanosis of the conjunctiva—report of a case," Dr. Robert L. Randolph.

Discussed by Drs. de Schweinitz and Quackenboss.

10. "Acquired symmetrical opacities of the cornea of unusual type," Dr. George F. Libby.

Discussed by Drs. Randolph, de Schweinitz, Clark, and Libby.

11. "Blepharochalasis—report of two cases," Dr. Edward Stieren.

Discussed by Drs. Ziegler and Stieren.

12. "A case of chronic sporotrichosis of the eye," Dr. Arthur J. Bedell.

EXECUTIVE SESSION.

TUESDAY EVENING, MAY 12TH.

The President, Dr. Robert Sattler, called the meeting to order at 8:45 P. M.

It was moved and seconded that the reading of the Minutes be dispensed with. (Carried.)

The President announced the appointment of the following Committees:

Committee on Membership.—DRS. HIRAM WOODS, W. H. WILMER, RICHARD A. REEVE, ALEXANDER QUACKENBOSS, and ARNOLD KNAPP.

Bulletin Committee.—DRS. G. E. DE SCHWEINITZ, W. T. SHOEMAKER, and WILLIAM M. SWEET.

Auditing Committee.—DR. T. B. HOLLOWAY.

Publication Committee.—DRS. WILLIAM ZENTMAYER, W. E. LAMBERT, and WILLIAM M. SWEET.

The Treasurer's report was read, and, the Auditing Committee having certified to its correctness, it was accepted and placed on file.

On motion of the Secretary it was voted that the assessment for the current year be five dollars.

The Secretary announced the death of three members during the year:

Dr. David Coggin, of Salem, Mass.;

Dr. John Green, of St. Louis;

Dr. N. M. Semple, of St. Louis.

The Chair appointed Dr. J. A. Spalding, of Portland, Me., and Dr. Arthur E. Ewing, of St. Louis, to draft suitable memoirs of Dr. Coggin and Dr. Green for publication in the Transactions.

The Chair appointed Dr. William M. Sweet, as delegate.

and Dr. William Zentmayer, as alternate, to the International Congress of Ophthalmology, at St. Petersburg, Russia, August, 1914; and Dr. Edward Stieren, as delegate, and Dr. Lewis H. Taylor, as alternate, to the Clinical Congress of Surgeons of North America, at London, July, 1914.

The Secretary read a communication from the Secretary of the Congress of American Physicians and Surgeons in reference to the selection of representation of the Society to the Executive Committee to arrange for the Congress of 1916. Dr. William H. Wilmer was appointed delegate and Dr. John E. Weeks alternate on the Executive Committee of the Congress.

The report of the Committee on Time and Place of Meeting was read by the Chairman, Dr. Libby:

Your Committee unanimously recommend that the Society meet at New London, Conn., on Tuesday and Wednesday, July 6 and 7, 1915. I should like to say that the Colorado members were very desirous of having the Society meet at some place in Colorado next year, and that the Colorado Ophthalmological Society was very much interested, and would have done everything possible to add to the enjoyment of your visit. Nevertheless, I voted for New London, in order to make this recommendation unanimous, because, after canvassing the ground thoroughly with the other members of the Committee, I felt that it was best for the Society to go there, as the majority were in favor of it. The postal card vote of the members of the Society showed seventy-nine in favor of meeting in the East and seventy-one in favor of meeting in Denver. Of course, this was not binding, but it showed what it was best for us to do, all things considered. So it was decided in that way.

It was moved and seconded that the report of the Committee be adopted. (Carried.)

The Committee on Membership presented the following nominations of officers of the Society for the ensuing year:

President: Dr. M. H. Post, St. Louis, Mo.

Vice-President: Dr. G. E. de Schweinitz, Philadelphia.

Secretary-Treasurer: Dr. William M. Sweet, Philadelphia.

It was moved that the Secretary be authorized to cast a ballot for the election of the officers as nominated by the Committee, which motion was carried, and the officers were declared elected.

The Committee recommended the following-named candidates for admission to the Society, and they were declared elected as Associate Members:

Dr. W. Holbrook Lowell, Boston, Mass.
Dr. J. Milton Griscom, Philadelphia.
Dr. Walter B. Weidler, New York City.
Dr. Edw. B. Heckel, Pittsburgh, Pa.

The Committee also referred the names of other candidates to the Committee for 1915.

Dr. Callan made the following statement: The Committee on Membership is often at a loss to determine the fitness of a man to enter the Society, because the information furnished by his sponsors is lacking in satisfactory data. Therefore, the Committee recommends the following form to be filled out by the sponsors of candidates:

Name.
Age.
Address.
Preliminary education.
Date of graduation.
Medical college.
Training in ophthalmology.
Medical college and hospital and clinical appointments.
City, County, State, and National Medical Societies of which he is a member.
List of contributions to ophthalmic literature.
Sponsors' personal opinion of the character, professional and ethical standing of their candidate.

It was moved and seconded that the recommendations of the Committee on Membership be adopted. (Carried.)

The Secretary read the report of Dr. Lucien Howe, delegate to the Fourth International Congress of School Hygiene.

The Congress was a marked success in point of attendance and in the interest manifested. Considerable attention was given to the hygiene of the eyes of children, to the construction of school furniture, and to methods of lighting. One paper presented by a member of this Committee dealt with the importance of the erect position of the child as a factor in the prevention of myopia. The discussion showed how great was the interest of educators in this and in similar questions, and thus how intimate the relation between pedagogy and ophthalmology.

The Committee on forming a National Organization for the Study of Cancer presented no report, and it was moved that the Committee be continued. (Carried.)

The Secretary read the proposals for membership, and they were referred to the Committee on Membership for 1915.

Dr. Wilder said that, in view of the fact that our retiring Vice-President and newly elected President, Dr. M. H. Post, of St. Louis, has been seriously ill, and is greatly disappointed in not being able to attend the meeting, he moved that the Secretary be instructed to send a message of sympathy to Dr. Post, expressing our hope that he may soon recover his health. (Carried.)

The Secretary read a communication from the Illuminating Engineering Society asking that a committee be appointed to co-operate with a similar committee of that Society in the study of the question of standardization of the illuminating of test cards and of perimeters.

The President appointed on the Committee Drs. Walter B. Lancaster, G. S. Crampton, and H. M. Langdon.

The report of the Committee on Revision of the Constitution and By-Laws, which consisted of Drs. G. E. de Schweinitz, Edward Jackson, John E. Weeks, S. D. Risley, and

Myles Standish, announced that changes recommended in the Constitution and By-Laws had been printed and distributed to all members of the Society, and the Chairman, therefore, moved, in order to bring the matter before the Society, that the report of the Committee be adopted.

Dr. Woods thought that, if the Council was empowered to select subjects for consideration and discussion, and it was also made mandatory on the Secretary to include in the printed call all voluntary papers received, there was the possibility of a greater number of papers being offered than could be used. The Secretary explained that the arrangement of the program was in charge of the Program Committee, and the Secretary included in the call the titles and abstracts of papers as arranged by that Committee.

Dr. Wilder asked whether the provision in regard to the nomination and election of members permitted a candidate, after his name had been proposed, to defer the presentation of his thesis for a period of two years.

Dr. de Schweinitz stated that, if a candidate does not present a thesis in the two years allowed, his name is dropped, and he must again be proposed for membership. No action is taken by the Council on the name of any candidate until the Committee on Theses has presented its report.

Dr. Wilder said that he was opposed to the provision requiring the writing of a thesis by the candidate, as he felt it was a form of examination, and he thought that any one who is considered eligible for membership in the Society should be above the necessity for an examination.

Dr. de Schweinitz pointed out that the presentation of a thesis was not an examination. It was simply a return to the old technic of the Society, although he was not sure it had been obligatory; also the presentation of a thesis was required by certain other scientific societies. The recommendation of the Committee was the result of a request from the Committee on Membership to establish a definite standard of eligibility.

Dr. Clark approved the recommendation of the Committee in the matter of a thesis, and thought it a proper stand for the Society to take, putting the Council in a more dignified position.

Dr. Pusey thought that a claim for membership in the Society should be founded on something better than a mere thesis.

Dr. Callan, while not in full accord with the idea of a thesis, believed that, if this plan will assist the Committee on Membership, it should be adopted. The Committee desired to be impartial with the candidates for membership, but it was difficult with the scant data frequently furnished by the sponsors.

Dr. Wilder heartily approved the recommendation regarding the thesis. He only raised the question originally because he wanted to know why the Committee set the limit at two years. It seemed to him that it might as well have been one year, because the candidates will know of the requirements and be prepared to present a thesis.

Dr. Weeks said that the Committee had regarded the matter of the two-year limit from all points of view, and decided that it was wise to recommend the presentation of a thesis. The time was made two years because it was thought that a man might be engaged on some particular work that could not be completed inside of a year. The candidate can present a thesis inside of a year if he wishes.

The question of adopting the recommendation of the Committee, as embodied in the printed copies of the Constitution and By-Laws, was then put, and carried.

The report of the Committee on Diploma in Ophthalmology was read by Dr. de Schweinitz, the Chairman of the Committee, who explained the manner in which the recommendations of the Committee had been determined.

Dr. Harlan asked as to the willingness of schools of the first class to establish the course of instruction as outlined;

whether it is the expectation that it shall be given in so-called post-graduate schools; and was there any school that had started this system of teaching?

Dr. de Schweinitz, in reply, said that there is at present in the United States one school, the University of Colorado, which conducts a successful course of the type described. The American Medical Association and the American Academy of Ophthalmology and Oto-Laryngology have appointed similar committees that are prepared to make recommendations along similar lines, and it seemed to him that, if all the recommendations are adopted, it would be wise to establish a combined committee of this and the other societies, which committee shall recommend some plan of action to the medical schools of the country as the expression of the opinion of the ophthalmologists of America. With such a backing, it would be practically impossible for any first-class medical school in this country to disregard the recommendation.

Dr. Lancaster asked what is meant by "a reasonably liberal amount of time" to be devoted to clinical ophthalmology? Is this amount of time to be part of the two years or in addition to the two years? Should the proper title of the degree be "Master of Ophthalmology" or "Master in Ophthalmology"? He suggested that the Committee insert the word "this," between "of" and "time," on the sixth line, of the fourth paragraph, so that it shall read "a reasonably liberal amount of this time."

Dr. Wilder desired to know whether the Committee considered it necessary that this two years' course of study should be a continuous period, or would it be possible for the candidate to take an interrupted course of two years. He thought that this was the method pursued in the University of Colorado by Dr. Jackson. The report merely says that all the courses need not necessarily be taken consecutively in one university or recognized ophthalmic hos-

pital. If the sentence were made to state that the whole period of two years need not be consecutive, it would receive his fullest approbation.

Dr. de Schweinitz thought the better title would be "Master in Ophthalmology." He believed that the Committee would be willing to adopt Dr. Wilder's suggestion and state more explicitly that the course need not be consecutive. In reply to Dr. Lancaster's question concerning the term "liberal," he said that the Committee deemed it unwise to dictate to any first-class school the exact amount of time which should be devoted to clinical ophthalmology, as each such school would naturally wish to be its own judge in this respect. He therefore moved that the recommendation of the Committee be adopted, with the insertion of the word "this" before time, on the sixth line, of the fourth paragraph, as suggested by Dr. Lancaster; and also the word "or" in the third line of the next to the last paragraph, to meet the point raised by Dr. Wilder.

Dr. Duane believed that there should be required at least two years of general practice in medicine or surgery, preferably in a general hospital, before a degree in ophthalmology is granted. He desired to ask whether this two years' requirement could not be satisfied in less time, provided continuous work were done covering a greater part of each year. He had a mild criticism to make of the term "Master in Ophthalmology" inasmuch as "Master" is a subordinate degree to Doctor and one of less dignity. Why could we not use the well-known term, "Doctor of Philosophy," specifying "in Ophthalmic Science"—the degree of Doctor of Philosophy being given for special work in any scientific branch?

Dr. de Schweinitz, in answer to Dr. Duane's objection with regard to the absence of any recommendation on the part of the Committee regarding work in general medicine, said that practically all the State Boards now require a stu-

dent to have had, before he comes up for examination before the Board, the equivalent of one year in a hospital. Therefore, he thought that that point was covered when the report stated that the post-graduate work was to be done in a medical school of the first class, and therefore one approved by the Association of American Medical Colleges. The other matter referred to by Dr. Duane he would leave to the Society to discuss.

Dr. Standish said, in regard to the relative importance of "Master" and "Doctor," that since he had come to the meeting one member of the Society had told him that he is a Doctor of Medicine and a Master in Surgery, the latter degree having been received in England; and that his degree of Master in Surgery means that he has a special degree, while his degree of Doctor of Medicine means that he has a general medical degree.

Dr. Wilder said, in regard to the subject brought up by Dr. Duane, that he did not think there were enough schools in the A and A1 classes which demanded what ought to be required of a man entering the specialty of ophthalmology or any other specialty. A man about to practise any specialty of medicine would be very much better equipped for its practice if he had a broad foundation in general medicine. He cannot have this unless he has had some practical work, such as is outlined by some of the schools for the hospital, or fifth, year. It will not be long before many schools will be requiring this fifth year. If the announcement of Rush Medical College, of Chicago, for the coming year is read, it will be seen that after 1914 only those men will be permitted to matriculate who agree to take this fifth year; and there are other schools in the same class. It will not be long before many of the State Boards will also require this pledge. If the Society is going to adopt standards, now is the time to do it; and he thought it would be proper to insert in the first clause, "provided that these schools are

recommended for Class 1 by the American Medical Association, and have the required fifth year; or provided the candidate has a fifth year as interne in an approved hospital. If he has not had such an interneship in a general hospital, he shall be required to have two years of general practice before becoming a candidate for the degree of Master in Ophthalmology."

Dr. Zentmayer thought that part of the preamble was not quite clear. It says that the Committee urges that the members of the American Ophthalmological Society shall use their influence to prevent the establishment of any degree in ophthalmology as a substitute for the degree of Doctor of Medicine, and that they shall oppose the establishment of any special school in ophthalmology independent of schools which grant the degree of Doctor of Medicine after the fullest preparation, which preparation must necessarily include a full measure of time in ophthalmic work. The way the sentence reads, it would mean that the Committee recommends that there should be no post-graduate schools.

Dr. de Schweinitz, replying to Dr. Zentmayer, said that the recommendation of the Committee does not refer to post-graduate schools, inasmuch as such schools receive as students only those who come to them equipped with the degree of Doctor of Medicine. He further said that the Committee would accept the addition proposed by Dr. Wilder.

Dr. Theobald suggested that the exact wording of the paragraph be left to the Committee, provided it fulfilled the requirement of Dr. Wilder's amendment.

The original motion, with the several amendments, was then adopted.

It was moved and carried that the Committee be continued and that its members be instructed to get into touch with the similar committees of the American Medical Association and the American Academy of Ophthalmology and Oto-Laryngology, so as to co-operate with them in forming

a well co-ordinated plan for the adoption of this course in ophthalmology by the medical schools.

Dr. de Schweinitz stated that he would like, on behalf of his colleagues of the Committee, to express his high appreciation of the kind reception that had been accorded the report.

Dr. Harlan moved that a special vote of thanks be given to the Committee for the work it had done. (Carried.)

The report of the Committee on Diploma in Ophthalmology as amended and adopted is as follows:

Report of the Committee on Diploma in Ophthalmology.

The purpose of the present report is to make certain recommendations with reference to granting a special degree in ophthalmology after a period of post-graduate work in a medical school of the first class, and therefore in one approved by the Association of American Medical Colleges, with the understanding that the medical education of the applicant for this degree, in addition to the regular medical course of four years, shall include one year as interne in a general hospital, or, in the absence of the latter, two years in general medical practice. Should this report be accepted by the American Ophthalmological Society, it would constitute the recommendation of this Association in this respect.

At the outset your Committee desires to place itself most firmly upon record that this special degree in ophthalmology shall be granted only as a reward of post-graduate work, and not as a degree obtained without the fullest course in general medical education and all which pertains to it. The Committee desires most emphatically to condemn the sentiment rife in certain quarters that a student may graduate in ophthalmology, so to speak, without a general medical course, and use a degree so obtained as a substitute for the degree of Doctor of Medicine. To divorce preparation for the practice of ophthalmology from a complete medical education would be as senseless as to divorce preparation for the work in cardio-vascular disease from a complete knowledge of the workings of the rest of the economy, and

the Committee urges that the members of the American Ophthalmological Society shall use their influence to prevent the establishment of any degree in ophthalmology as a substitute for the degree of Doctor of Medicine, or that there shall be any special school in ophthalmology independent of schools which grant the degree of Doctor of Medicine after the fullest preparation, which preparation must necessarily include a full measure of time in ophthalmic work.

With this understanding the Committee approves the idea that in all universities and medical schools of the first class a course shall be arranged to give graduates of such standard medical schools the best assistance in preparing for ophthalmic practice with the greatest economy of time; to give those already engaged in ophthalmic practice similar assistance in making up for educational defects which were inevitable when no systematic supervised course of the kind was given, and to render accessible to those already engaged in ophthalmic practice recent advances in ophthalmic science and art. Inasmuch as the applicant for a course of this character must have the degree of M.D., he must also have passed the entrance examination of the school from which this degree was obtained, and therefore have received the preliminary education which such passing has required. The Committee suggests that it is desirable that during such preliminary education he should have become familiar with algebra through quadratic equations, geometry, plane and solid, plane trigonometry, and should acquire a fair knowledge of optics.

Post-graduate Ophthalmic Work for a Special Degree in Ophthalmology.—The Committee agrees to recommend that two years shall be devoted to the course; that is, this period of time shall be devoted to the study of ophthalmology and subjects directly related to it, with the understanding that a reasonably liberal amount of this time shall be devoted to clinical ophthalmology in any ophthalmic hospital having proper facilities for the study of clinical ophthalmology and with the requisite clinical service. It is recommended that the course of study during these two years in general terms shall include an academic and a laboratory period, during which the following courses should be available:

1. A course on the cadaver in the anatomy of the head, and therefore including the eye and its appendages; dissection of the accessory sinuses and regional anatomy of the brain; the embryology and histology of the human eye; also comparative anatomy and histology.

2. A course in physiological optics and the physiology of vision with opportunities for work in comparative physiological optics.

3. A course in practical ophthalmology, which should include a full measure of time devoted to the refraction of the eye, to learning the use of all instruments of precision in ophthalmic work, to work in theoretic and experimental dioptrics, to work in the anomalies of muscle balance, and to diseases of the eye and to medical ophthalmoscopy.

4. A course in the surgery of the eye, which should include work in perfecting operative technic on the cadaver or with animals' eyes, supervised by a teacher competent to instruct in this branch.

5. A course in pathology of the eye, covering practical work with the microscope and including a course in bacteriology and work in the theory of serum and vaccine therapy.

6. A course on the diagnosis and treatment of syphilis, in which special attention shall be paid to the pathological condition which it creates in the eye and nervous system.

Character of the Degree.—Although among oculists at large there is some difference of opinion in regard to the character of the degree which shall be granted after proper examination on the subjects already named, the opinion of a majority of the Committee is that the title, if gained, should be Master in Ophthalmology and not Doctor of Ophthalmology, because in the opinion of a majority of the Committee the title Master in Ophthalmology is the more dignified of the two, largely for the reason that it comes less in conflict with other titles that are now being conferred, sometimes regularly, for example, Doctor in Hygiene or Diploma in Public Science, and the like, and sometimes irregularly by certain organizations in this country, which might readily be confounded with the degree of Doctor of Ophthalmology, for instance, the so-called degree D. O., which stands for Doctor of Osteopathy.

Examinations and Requirements for Obtaining the Degree

of Master in Ophthalmology.—(1) It is recommended that the candidate shall present a thesis covering original work, which shall not be accepted by the Board of Examiners unless it is of sufficient worth to be published.

(2) The candidate must pass a satisfactory examination in all the various courses outlined in the previous recommendation, and before he presents himself for examination he shall be able to exhibit a certificate or certificates showing that he has done a suitable amount of clinical ophthalmology in a hospital or institution recognized by the examining board as competent to supply the necessary opportunities.

(3) The candidate shall be permitted to offer work done in subjects a list of which is the following:

a. The embryology or histology of the eye.
b. The comparative anatomy of the eye.
c. Comparative physiological optics.
d. Original laboratory investigations of the anatomy or physiology of the human eye.
e. Original laboratory investigations on the transmissible diseases of the eye, or other pathological ocular conditions.
f. Original investigations into ocular symptoms or conditions resulting from, or related to, any disease of other organs of the body.

(4) The candidate shall, if he desires, be examined on any one of these subjects, and the time that he has spent upon them and the character of the examination which he passes upon them shall be accepted by the Board of Examiners as evidence of his availability for the degree and counted accordingly, with the understanding that this does not in the least excuse the candidate from any necessary knowledge on the other subjects which have already been outlined, to wit: (1) The dioptrics of the normal and the abnormal eye, including practical work in the refraction of the eye and the anomalies of muscle balance; (2) abnormalities and diseases of the eye and its appendages, their etiology, pathology, diagnosis and treatment; (3) the relation of ophthalmology to general medicine; (4) clinical tests to illustrate the candidate's competency in 1, 2, and 3 of the previous recommendations; (5) an examination in ophthalmic surgery. The examination shall be written or oral, or both, and practical.

(5) The candidate for the degree of Master in Ophthalmology, it is recommended, need not necessarily take all of the courses above recommended consecutively, or in one university or recognized ophthalmic hospital. For example, the candidate may take part of the course in one city and part in another, but the final half year of his two years' course must be taken consecutively in that university or school from which he is to receive his degree after passing the final examination.

Finally, the Committee suggests that the examining board of the university or school which grants this degree shall include a representation from the department of physiology or anatomy, the department of pathology or bacteriology, the department of medicine or surgery, and in addition to one or more representatives of the department of ophthalmology. In other words, it is desirable that the Examining Board shall not be one composed exclusively of representatives from the ophthalmic department.

G. E. DE SCHWEINITZ, *Chairman*
MYLES STANDISH
S. D. RISLEY
EDWARD JACKSON
J. E. WEEKS *Committee*

MORNING SESSION, MAY 13TH.

The meeting was called to order at 9.45 A. M., Dr. Sattler presiding.

It was moved and carried that the Society go into executive session.

The President announced that, according to the Constitution, the amendments to the Constitution and By-Laws acted upon at the meeting yesterday must be taken up at this session and adopted. It was then moved and seconded that the new Constitution and By-Laws as presented be finally adopted. (Carried.)

The President appointed the following Committee, provided for by the new Constitution:

Committee on Theses.—Drs. W. H. Wilder, Alexander Duane, and George S. Derby.

As the new Constitution provided for a Council to perform the duties formerly performed by the Committee on Membership, the President appointed the following:

The Council.—Drs. Hiram Woods, William H. Wilmer, R. A. Reeve, Alex. Quackenboss, and Arnold Knapp.

The Executive Session then adjourned.

The scientific meeting was immediately resumed, and the following papers read:

13. "Contraction of the frontalis in abduction of the eyeball," Dr. William Zentmayer.

Discussed by Drs. Lancaster, Ray, Weeks, and Zentmayer.

14. "A case of symmetrical occlusion of the pupils by the development of cysts and small solid masses from the uveal layer of the iris," Dr. John E. Weeks.

Discussed by Drs. Greenwood, Clark, and Weeks.

15. "The pathology of the corneal section and its complications in cataract extraction," Dr. Frederick Tooke.

Discussed by Drs. Theobald, Weeks, and Tooke.

16. "Psammosarcoma of the orbit in a girl of thirteen. Successful removal with preservation of the eyeball and its functions," Dr. G. E. de Schweinitz.

Discussed by Dr. Greenwood.

17. "Radium therapy in a case of orbital metastasis consequent upon an intraocular sarcoma," Dr. Robert Sattler.

Discussed by Drs. Theobald, Clark, Timberman, Friedenwald, Ellett, Zentmayer, and Sattler.

18. "Tuberculosis of the bulbar conjunctiva," Dr. George F. Libby.

19. "Report of a case of tuberculosis of the sclera of probable primary origin," Dr. George H. Bell.

Papers of Drs. Libby and Bell discussed by Drs. Weeks, Pyle, Davis, Theobald, Libby, and Bell.

20. "A case of alternating transient monocular blindness

ending in complete loss of vision in the left eye," Dr. H. Maxwell Langdon.

Discussed by Drs. Duane, Holloway, Weeks, Clark, Hunter, Zentmayer, de Schweinitz, Wilder, Friedenwald, Parker, and Langdon.

AFTERNOON SESSION, MAY 13TH.

21. "Retinitis with massive exudation," Dr. Harry Friedenwald.

Discussed by Drs. Weeks, Wilder, Harlan, and Friedenwald.

22. "The convergence index as a measure of the converging power," Dr. Alexander Duane.

Discussed by Drs. Lancaster, Lamb, and Duane.

23. "Curvature and index myopia, with report of cases," Dr. A. Edward Davis.

Discussed by Drs. Ellett, Stieren, Theobald, and Davis.

Adjourned.

Members present at the Fiftieth Annual Meeting:

ADAMS, A. E.
ALLING, ARTHUR N.
BAILEY, FRED. D.
BEARD, CHAS. H.
BEDELL, ARTHUR J.
BELL, GEO. H.
BUTLER, W. K.
CALLAN, LEWIS W.
CALLAN, PETER A.
CHARLES, J. W.
CLARK, C. F.
CRAIG, W. G.
CURDY, R. J.
DAVIS, A. E.
DODD, OSCAR
DUANE, ALEXANDER
ELLETT, E. C.
FRANCIS, LEE MASTEN
FRIEDENWALD, HARRY
GREENE, LOUIS S.
GREENWOOD, ALLEN
HARLAN, HERBERT
HOLLOWAY, T. B.
HOWE, LUCIEN
HUNTER, D. W.
INGALLS, JAMES W.
JAMESON, P. CHALMERS
KENNON, B. R.
KNAPP, ARNOLD
LAMB, ROBERT S.
LANCASTER, WALTER B.
LANGDON, H. MAXWELL
LIBBY, GEORGE F.
MACLEISH, A. L.

MILES, H. S.
OPPENHEIMER, HENRY S.
PARKER, WALTER R.
PAYNE, S. M.
PHILLIPS, R. J.
PUSEY, BROWN
PYLE, WALTER L.
QUACKENBOSS, ALEX.
RANDOLPH, R. L.
RAY, J. M.
REESE, R. G.
REIK, HENRY O.
SATTLER, ROBERT
DE SCHWEINITZ, G. E.
SHANNON, C. E. G.
SHANNON, JOHN R.
SHOEMAKER, W. A.
SHOEMAKER, W. T.
SMITH, E. TERRY
STANDISH, MYLES
STIEREN, EDWARD
SUTPHEN, T. Y.
SWEET, WM. M.
TAYLOR, LEWIS H.
THEOBALD, SAMUEL
TIMBERMAN, ANDREW
TOOKE, FRED. T.
WEEKS, JOHN E.
WHITE, J. A.
WILDER, WM. H.
WILLIAMS, EDWARD R.
WOODS, HIRAM
ZENTMAYER, WM.
ZIEGLER, S. LEWIS

A NEW OPERATION FOR THE REMOVAL OF TRUE AND FALSE PTERYGIUM, OR OTHER GROWTHS AT THE SCLEROCORNEAL JUNCTION.

C. H. BEARD, M.D.,
Chicago, Ill.

The procedure that I am now privileged to describe to you has first been thoroughly tried out. While, as stated in the title of this paper, the measure is equally applicable to pterygium, pseudopterygium and tumors over the sclerocorneal junction, and while the general underlying principles remain the same in each instance, the technic is somewhat varied according to the nature of the growth to be removed.

Primarily, the operation consists in the making of two incisions in the conjunctiva more or less vertical to the cornea, one on each side of the growth where it crosses the sclerocorneal junction; undermining or tunneling beneath the intervening membrane; passing a blunt-pointed knife through the tunnel, and shaving the growth from the cornea; the abscission of the growth (or of the head if it be a pterygium); dissection toward the base of the flap of conjunctiva; the formation of two lateral sliding flaps, so fashioned that, when their free ends are brought together, not only is the bared scleral area covered but a bridge of smooth, normal conjunctiva is interposed between the raw surface on the cornea and the base of the flap from which the growth has been excised; and, to complete the operation, three or more fine sutures are introduced to hold the loosened portions of conjunctiva in place till healing is insured. The technic is modified as it pertains

First—to *true pterygium.*

Second—to *false pterygium.*

Third—to *tumors.*

1. IN RELATION TO PTERYGIUM. This operation is particularly adapted to pterygia of medium and large dimensions, but in order the more thoroughly to understand the indications let us glance at the make-up of a good-sized *inward* pterygium, this being the situation in which the growth is most often found. The head in its progress toward the center of the cornea drags after it two diverging folds of conjunctiva. These folds are often of considerable depth, particularly as regards the upper one. There is a veritable movement outward of all the included membrane as it is pulled upon by the advancing head of the pterygium. The result, in the more pronounced types, is that the semilunar fold and the nasal culdesac are obliterated, the caruncle is elongated and drawn out of its normal seat in the commissure and lies upon the globe, and the outward rotation of the eye is restricted. Surgical intervention, therefore, should have for its object not alone the permanent freeing of the cornea from the encroaching presence of the growth, but also the correction of the defects and deformities just mentioned, and all with a *minimum* sacrifice of the mucous tissue. Please note the points here emphasized—*permanent cure in all respects without needless waste of membrane involved.* With very few exceptions the measures devised for pterygium have sought only to relieve the corneal conditions. This they have accomplished by transplanting and burying the growth so that any further progress would be in a different direction. Such are the well-known operations of Desmarres and of McReynolds, with the advantage, however, in favor of the Desmarres method in that it entails no loss of tissue. Or they have embodied some mode of excision. It will be remembered that pterygium occurs most often after middle life, in eyes that have been for years afflicted with conjunctivitis; hence, there is always present a degree of atrophy of the affected membrane, and in our intervention, instead of increasing the deficiency we might

perhaps better strive to lessen it, as did the late Dr. Hotz, by means of a Thiersch graft.

The procedure which the one under discussion most nearly resembles is that of Prof. Herman Knapp, yet the differences are sufficiently essential, as the following description will show:

Technic for pterygium.—The two conjunctival incisions do not follow the borders of the pterygium, but are much less divergent. They begin just where the border crosses the limbus and are carried to the bottom of the nasal cul-

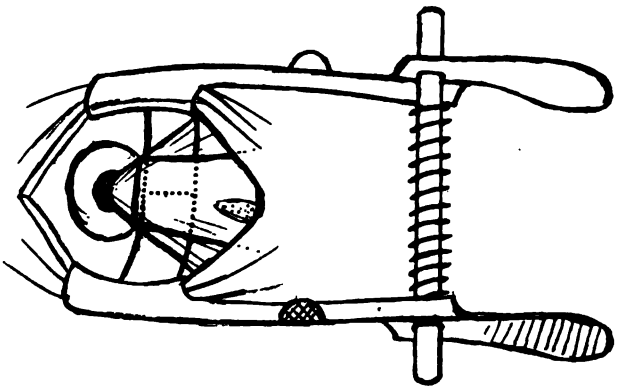


Fig. 1.*—The operation as applied to pterygium. The heavy lines show the conjunctival incisions. The dotted lines indicate how the sliding flaps are brought together to cover the defect. The caruncle is represented as drawn out by the pterygium.

desac but slightly diverging. One remembers that these incisions include only one layer of conjunctiva, that is, they do not go through the two layers which comprise the border folds of the pterygium. The neck of the growth, together with the subconjunctival connective and elastic tissue, is loosened from the sclera by the small curved blunt-pointed scissors. A narrow curved blunt-pointed bistoury is passed through—*in* at the lower incision, *out* at the upper, with its

*Through an error, the speculum is put in wrong; *i. e.*, with the handles over the nose.

edge toward the limbus. The body of the pterygium is grasped by broad-jawed forceps, and its head, inclusive of a thin shaving of the substantia propria, is sliced from the cornea by slow and studied sawing with the knife. The head, and that portion only, is cut squarely off with straight scissors. The dissection is then carried inward beneath the conjunctiva included between the two primary incisions, taking care not to open Tenon's capsule, until the base of the flap thus formed is at the bottom of the nasal fornix, or, at least, where the fornix should be. The flap is pushed strongly in the direction of the nose so as to replace the caruncle and to reëstablish the inner fornix. If desired, it may be there fixed by two sutures, one above and one below. Now, two perpendicular flaps of conjunctiva are made by cutting through the folds that constitute the borders of the pterygium, their width exactly proportioned to the extent of retraction imparted to the flap from which the head of the growth was abscised. Seeing that the cuts that form the lateral boundaries of the last named, or sliding flaps, pass through membrane that is folded upon itself, they will need to be not at all, or but slightly, prolonged in the direction of the upper and lower fornices. In freeing the ends of these flaps care must be exercised or, owing to their being folded upon themselves, the conjunctiva will be buttonholed. The two flaps are drawn across the defect and butted together, and thus held by a single suture placed much nearer their temporal than their nasal borders. Their two nasal corners are made fast, each with a single suture, to the original stump of the pterygium, and the operation is finished.

Thus the trend of the "grain" of the original growth is diverted, as in the Knapp operation, the caruncle is replaced, the internal fornix is restored, and the border folds of the pterygium are utilized to furnish the material for an impassable barrier that lies between the base of the pterygium and its former pernicious encroachment upon the cornea.

2. IN RELATION TO PSEUDOPTERYGIUM. Here the measure finds its application only as concerns growths of small and medium extent. The technic is practically the same as that described in connection with true pterygium, but the bulbar conjunctiva is often so scant or so cicatricially bound down as to render the sliding flaps impractical and to necessitate the substitution of a Thiersch graft in their stead.

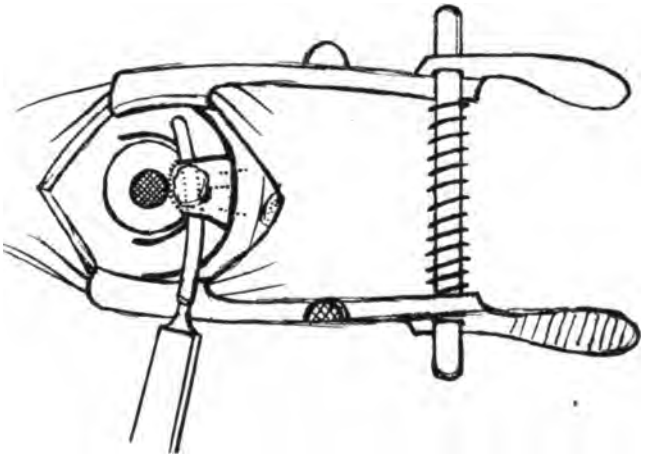


Fig. 2.*—The operation as applied to tumors at the sclerocorneal junction. The heavy lines show the conjunctival incisions. The knife is in the act of shaving the growth from the globe. An effort has been made to show, by dotted lines, the butting together of the sliding flaps, and how they are held away from the cornea by two sutures.

3. IN RELATION TO TUMORS. The operation was first resorted to for the removal of small tumors whose location was over the union of sclera and cornea. A number of these, such as papillomata, pigmented nevi, dermo-epitheliomata, and fibro-elastic tumors, were extirpated by the method before it was employed for pterygium. The technic is here decidedly modified to meet the requirements. The

*Through an error, the speculum is put in wrong; *i. e.*, with the handles over the nose.

initial incisions are extended only far enough from the cornea to allow a line drawn between their distal extremities to safely clear the tumor. After tunneling under and shaving off the tumor the latter is excised as in case of pterygium, but there is no dissection of that portion of the conjunctiva from which the excision was made. In preparing the sliding flaps to cover the defect, the incisions are made almost parallel with the base of the cornea, so that, when their ends are brought together, the flaps have a tendency to overlap the cornea. But when they are sutured to the raw edge of conjunctiva on the other side they are drawn clear of the cornea. Hence the reason for not carrying the dissection beneath that portion of the conjunctiva becomes apparent.

A NEW OPERATION FOR CAPSULO-MUSCULAR ADVANCEMENT, COMBINED WITH PARTIAL RESECTION

S. LEWIS ZIEGLER, M.D.,

Philadelphia.

Probably the earliest form of advancement of the extrinsic muscles of the eyeball was that of capsulo-muscular advancement, which procedure grew out of the expediency of having to readjust certain cases of overcorrection after the operation of tenotomy, which at that time was usually accompanied by a too free division of Tenon's capsule and the consequent protrusion of the globe through the capsular breach.

To Critchett belongs the credit of having first presented a well-planned technic for muscular advancement, and it is surprising how many since his time have simply made slight modifications of this method. Landolt gave a great impetus to muscular advancement through his campaign

against the failures of tenotomy, which most operators recognized was too radical a procedure as then practised, and yet they made no systematic attempt to remedy its defects. They were, therefore, quite open to conviction on the points raised in the propaganda preached by Landolt.

Certain features of the necessary technic of this operation have been emphasized by individual operators. Almost all of the earlier surgeons employed the *guy-thread* to supplement the procedures practised by them. The *pulley* principle was made use of by Weber, Prince, Beard, and Hulen. The advantages of the *single-stitch* method were emphasized by Williams, Jackson, Oliver, and Lea. A *circumcorneal interrupted suture* was used by Argyll-Robertson, Howe, and Cogan to secure a firm anchorage; while *true anchor sutures* buried in the sclera near the insertion of the tendon have yielded good results in the hands of Prince, Jackson, Black, and Verhoeff.

The *tendon* was *split* by Valude before attaching the divided segments to the sclera, above and below. A similar technic was practised by Emerson. *External loop sutures* have been employed by Worth and Stevenson, the former tying each one separately and the latter using them as a slip loop to make uniform traction. Stevens *excised a triangle* of the tendon without total division and advanced the central portion remaining. Colburn added to this type of excision a *splitting* of the tendon. Magnani utilized the splitting of the tendon but without excision.

Lagleyze followed the technic of Williams but without section of the muscle, thus forming a loop or tuck in the tendon. Suffa employed a more elaborate loop suture and anchored it in the tendinous insertion. The more complicated technic of instrumental tucking has been cleverly elaborated by Maxwell, Clark, Bruns, Greene, and Todd, while Briggs has added metal clamps to hold the fold in situ.

Resection of the muscle, as performed by Noyes, had a

considerable vogue for several years, while Schweigger, Müller and others presented a somewhat more elaborate technic. It has been employed in conjunction with most of the advancement operations I have mentioned. The method recently outlined by Reese has also proved its excellence.

De Wecker began the use of capsular advancement by using the stitch of Weber in a modified way, but Knapp soon improved on this technic by employing Critchett's method of introducing the sutures. The success obtained by Knapp in readjusting overcorrected eyes led me to try it with good results, and later caused a change in the technic of the operation I shall present to you today, by including the capsule in the suture. Fox followed de Wecker's technic but excised a fold of capsule and conjunctiva. Trousseau aimed to secure a similar effect by his more simple capsular ligature.

Wandering through this wilderness of technic what can we select as the essentials of success in the correction of heterotropia by advancement?

The following fundamental elements should at least be given serious consideration:

1. *Firm anchorage* must be obtained either in the sclera or in the tendinous insertion of the muscle.

2. *Firm fixation* of the muscle must be made without strangulation, displacement, or tearing of the fibers.

3. A *straight parallel pull* must be secured by equal traction on each margin of the muscle.

4. *Advancement of the capsule* will increase the effect, and is specially efficient in readjustment.

5. A *single suture* has the double advantage of simplicity and efficiency.

6. An *external suture* is more accessible for removal.

The enthusiasm of the ophthalmic world over the correction of heterophoria and heterotropia which followed the

publication of the valuable pioneer studies of Stevens, led me in the early nineties to devise a convenient prism scale* with a table of resultant prisms, a Greek-cross test-object for heterophoric examinations† and an operation designated "bilateral partial tenotomy,"‡ all of which have previously been published; and finally, the advancement operation which I shall here describe. To avoid certain well-recognized dangers I decided to follow the principles laid down in my description of bilateral partial tenotomy, that "by the preservation of a central fasciculus the motility of the eyeball is undisturbed, the traction power of the muscle is retained, its insertion is unchanged, and vertical tilting of the axis is avoided." Having this in view, I planned to imitate the technic used in my partial tenotomy and to make a partial resection of the muscle by excising a V-shaped piece from each margin without dividing the central fibers of the muscle. By preserving this central tongue the advancement somewhat resembles a tucking operation, with the knuckle excised, although the distribution of the wrinkles in the muscle gives it more the appearance of crumpling rather than of folding.

MUSCULAR ADVANCEMENT WITH PARTIAL RESECTION AND CONJUNCTIVAL SUTURE.

The description of the operation at first devised is as follows:

First stage: A primary conjunctival incision is made 4 mm. from the limbus and extending about 10 mm. in a vertical direction. A tenotomy hook is then slipped under the muscle to raise it up.

Second stage: One needle of a double-armed suture (No. 1

**Annals of Ophthal. and Otol.*, July, 1893.
†*Trans. Pan-Amer. Med. Cong.*, 1893, vol. ii, p. 1472.
‡*Ophthalmology*, April, 1911.

braided black silk) is now passed through the muscle at its *lower* marginal third, going from the outer surface toward the sclera, at about 10 mm. back of its insertion. The same movement is then repeated a little in *advance* of the first, thus forming a secure "whipstitch" on the edge of the muscle. The second needle is now inserted at the *upper* marginal third of the muscle and the "whipstitch" repeated at that point.

Third stage: The tenotomy hook is now transferred to an assistant, the threads are grasped tightly, the muscle is drawn taut and with small sharp-pointed scissors a wedge or V-shaped piece is cut away from each marginal third of the muscle, thus leaving the fibers of the central third intact.

Fourth stage: Grasping the upper needle firmly with the needle-holder it is inserted *beneath* the conjunctiva at the upper corner of the wound, and pushed rather *deeply into the sclera* in a diagonal direction, to emerge *on* the conjunctival surface near the horizontal plane of the cornea. The same maneuver is then repeated with the lower needle and suture, which should emerge near the same spot.

Fifth stage: The two free suture ends are now tied in a surgical knot, which is drawn taut until the squint appears to be a trifle overcorrected, when the final knot is tied. The tendon and muscle now appear to be crumpled together somewhat like a tucking advancement, but without the unsightly knuckle. The margins of the conjunctival wound are then approximated over the muscle by two supplementary sutures of thin black silk (No. 0). This makes three sutures necessary for this operation.

The success which I achieved with the capsular advancement of Knapp in many cases of readjustment that were the sequelæ of the older methods, coupled with the ambition to secure equally good effects with my own procedure in similar cases, and a desire to have a single suture do all the work, led me to devise the following modification of this operation,

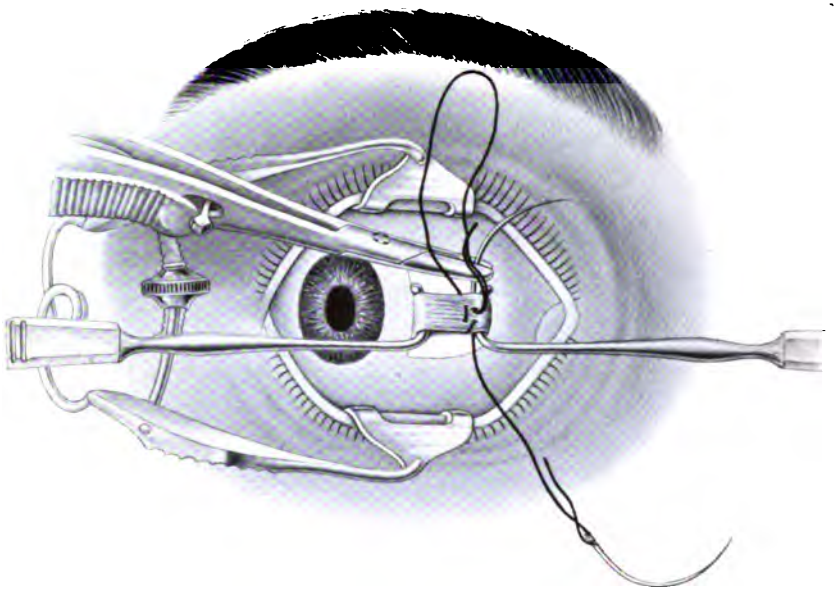


Fig. 1.—First and second stages. The muscle is held taut on two tenotomy hooks. One whipstitch has been placed on lower margin and the other is being inserted at upper margin.

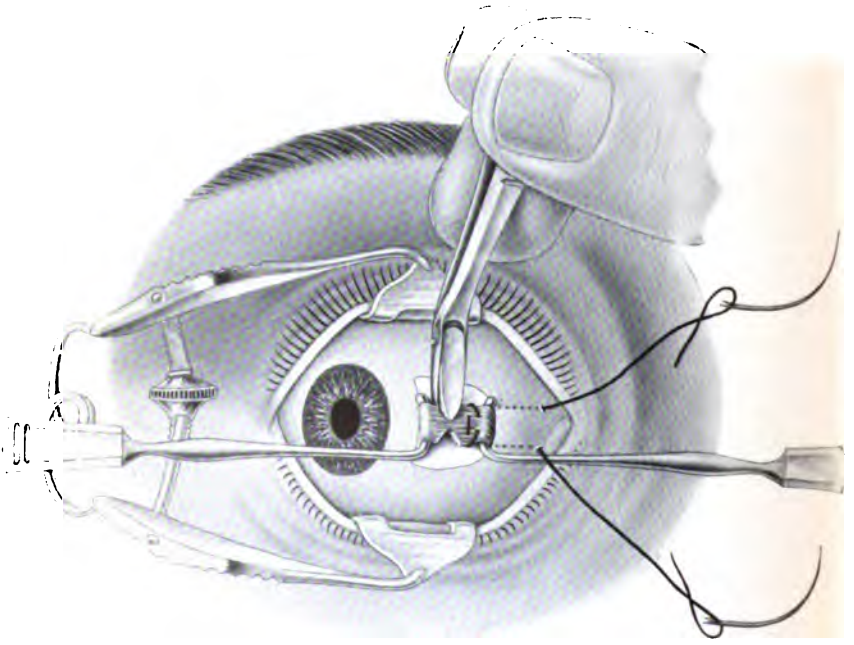


Fig. 2.—Third stage. Both needles have been passed back under Tenon's capsule and out to conjunctiva. A wedge or V-shaped piece is being excised from each margin.

which I have practised for many years almost to the exclusion of the earlier technic:

CAPSULO-MUSCULAR ADVANCEMENT WITH PARTIAL RESECTION. A SINGLE STITCH METHOD.

First stage: A primary incision is made in the conjunctiva 4 mm. from the limbus and extending about 10 mm. in a vertical direction. Two tenotomy hooks are then introduced from below upward, one beneath the tendon and the other beneath the muscle, both hooks being slightly raised and the tissues put on a stretch by an assistant.

Second stage: One needle of a double-armed suture (No. 1 braided black silk boiled in equal parts of paraffin and vaselin) is entered in the muscle at its *lower* third and passed from the outer surface toward the sclera at a point about 10 mm. back of its insertion. The same maneuver is then repeated by entering the needle a little *behind* the first puncture, thus making a firm "whipstitch" on the lower edge of the muscle. The second needle is now passed in like manner through the muscle at its *upper* third and again entered 2 mm. behind this point, thus forming a second "whipstitch" in the *upper* margin of the muscle. This gives us a central restraining thread and two lateral binders which will grip the margins tightly without slipping or tearing the muscular fibers (Fig. 1).

Third stage: Each needle is then separately carried backward beneath Tenon's capsule toward the muscle body on a line parallel with each muscle margin and passed out to the conjunctival surface. With the muscle still held taut a wedge or V-shaped piece is excised from each margin with a special punch, or with scissors, and the central fibers left intact (Fig. 2).

Fourth stage: The upper needle is now carried forward and entered *through the conjunctival surface* between the limbus and upper extremity of the anterior wound edge, *dipping*

firmly into the sclera and emerging near the horizontal plane. The same maneuver is then repeated with the lower needle and suture, which should emerge near the same spot. The farther apart these needles are entered the more will the muscle be put on a stretch (Fig. 3).

Fifth stage: The two free suture ends are now tied in a primary surgical knot which is steadily but firmly drawn taut until the squint is slightly overcorrected. The effect can be graduated as desired. The secondary knot is then tied (Fig. 4).

Care must be taken to smooth out the conjunctiva with a silver spatula before finally tying the suture, as loose tags or small rugæ will prevent smooth healing. The two lines of sutures should be inserted as nearly parallel as possible to prevent any distortion of the tissues. They should firmly close the wound and hold the subjacent tissues perfectly flat against the sclera and will, therefore, act somewhat as a mattress suture. The muscle, the capsule, and the conjunctiva are thus superimposed, fixed and drawn forward to the point of anchorage.

If indications demand it the *pull* of the *opposing muscle* should be weakened either by (*a*) division of capsular adhesions, if present; (*b*) stretching of the tendon or of Tenon's capsule, as recommended by Panas and Fox; (*c*) bilateral partial tenotomy; or (*d*) complete tenotomy.

The usual after-treatment for advancement operations is indicated. The eye is kept bandaged for one week or less but the dressing is changed daily. In case of pain, inflammation or edematous swelling, the dressing should be wholly removed and ice pads applied. The sutures should be removed about the tenth day. This is easily accomplished as both the knot and the parallel lines of suture are exposed on the outer surface of the conjunctiva.

The advantages claimed for this operation are:

1. Firm scleral anchorage.

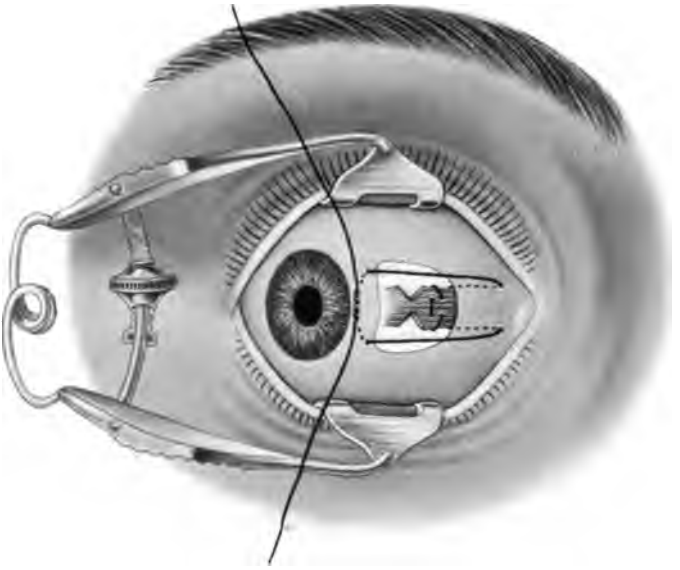


Fig. 3.—Fourth stage. Both needles have been carried forward, passed firmly into sclera near limbus, and ends of suture tied.

Fig. 4.—Fifth stage. The knot has been firmly tied. Two parallel lines and the knot are left exposed. Tissues are plicated and held flat.

2. Whipstitch fixation of each muscle margin.

3. Splintlike support of the muscle by parallel lines of suture laid across the superimposed conjunctiva, capsule and muscle, all of which are advanced together.

4. Straight traction on both muscle edges.

5. Graduated control while the suture is being tied.

6. Single suture, removable externally.

7. Partial resection, preserving the integrity of the muscle.

8. Tucking or crumpling of the muscle without an unsightly knuckle.

9. Reposition of the globe through advancement of the capsule.

10. Avoidance of the danger of the globe slipping farther back if by accident the suture should loosen or slough out.

DISCUSSION

DR. JOHN E. WEEKS, New York: I should like to ask Dr. Ziegler why, in the second operation, he passes the suture back beneath capsule and conjunctiva before bringing it out on the conjunctival surface. It apparently makes more traction on the conjunctiva than on the muscle.

DR. LUCIEN HOWE, Buffalo, N. Y.: I should like to ask whether in these cases there is not, after all, danger of the stitches pulling out. Of the various modifications of this method, I have always found, sooner or later, there were difficulties in anchoring the stitch. At last I have come back to the plan advocated a number of years ago, of making the anchorage to the tendons of the superior and inferior recti near their insertions. The fixation is absolute, and moreover with the loop suture it is possible to modify the effect as we wish after the operation. This method I described in my second volume on the muscles.

DR. W. H. WILDER, Chicago, Ill.: I think that the cardinal principle of all single-suture operations is wrong. If we figure out the lines of force in any of these single-suture operations, we must see that the tendon in every case will be crumpled, instead of being spread out. In Dr. Ziegler's

operation, if we draw the lines of force from the point of emergence of the suture in the tendon to the point of its attachment in the sclera, we will see that it cannot help but fold the tendon on itself, like a cord. I cannot see any way to spread the tendon out and give it wide attachment, except to have at least two stitches; one at each edge, with the lines diverging, instead of converging. The little extra time involved insures that the tendon attachment will be spread out and widened, if necessary; so that one may, by traction on the upper suture or the lower one, relieve any hyperphoria that may be present. In any operation for exophoria or esophoria, that is extremely important. It is well to have two sutures, or even three. One, to form the central point of attachment of the tendon, and two lateral ones. Then, by testing with the candle and Maddox rod, we can tell which one to tighten in order to correct any hyperphoria which may have been brought about. This is not done with any single-suture operation that I have tried.

DR. CHARLES H. BEARD, Chicago, Ill.: Dr. Wilder's theory sounds well, but I have been doing a single-suture operation for over twenty-five years, and have demonstrated at the finish of the operation, in case after case, that the tendon was spread out forward of its original attachment. Moreover, I have often illustrated the arrangement of the suture by means of a cord to represent the thread and a flimsy textile fabric to indicate the tendon. By giving to the cord the same divergent direction that is given to the suture in making the scleral anchorage the fabric is held smooth.

DR. WEEKS: The objection that Dr. Wilder has raised to single-suture operations is one that I have spoken of at a number of meetings. It has been my experience, in correcting failures, on dissecting up the attachment of the muscle to find it much contracted in cases in which single sutures have been employed. The operation certainly has that fault in some cases. The single suture, however (I mean the principal single suture), may be employed as in the Reese resection; if lateral sutures are put in, the muscle attachment can be spread so that there will not be the contraction that obtains in some cases of single-suture operations.

DR. ZIEGLER: In reply to the question of Dr. Weeks regarding the inclusion of Tenon's capsule, I may say that I tried to express in my paper the double advantage of advancing the capsule along with the muscle; reposition of the globe, and splint-like support of the muscle as you bring it forward. By passing the stitch back through the capsule the latter comes forward when you pull on the thread and is superimposed on the muscle; and all are then brought forward to the point of anchorage. Whether the suture is tight or loose depends on how much traction you make on the thread before you tie it.

Regarding the question of the single-suture, objected to by Dr. Wilder, I can only confirm what Dr. Beard has said. One suture is just as efficient a method of pulling the muscle forward as if you used a dozen sutures. In other words, it makes no difference how many sutures you use, the effect will be just the same provided you secure the proper traction. If you wish to make traction on the muscle margin in order to spread it out, you can enter the needle as high up as you choose, pass it down through the conjunctiva and sclera and emerge near the median line, thus spreading out the muscle as much as you wish.

Replying to Dr. Wilder's second criticism, I think that almost all muscles are crumpled to a certain extent. You cannot keep them smooth. These little muscles are so thin and delicate that it makes no difference how they are folded, unless the fold makes a knuckle. It was to avoid the slight effect of knuckling and piling up of the capsule in the original operation of Knapp that I cut out a V-shaped piece from the muscle margin. I frequently had to use ice compresses for a number of days after Knapp's advancement in order to reduce the chemotic edema. Nevertheless, it is one of the most efficient operations for re-adjustment that I know of. In many cases of over-correction left us by the older operators it has proved very successful in my hands. That is what led me to add this advancement of the capsule to my own operation. If you put the muscle on a direct pull it is immaterial how you bring it forward, providing it is well anchored and its action is not impaired.

Dr. Wilder evidently follows Von Graefe's suggestion that you should clip one side of the muscle to gain a vertical

correction. I believe, however, that hyperphoria is better corrected by its own operation of partial tenotomy. At least, that has proved to be more exact in my hands. I do not think that you can secure an accurate vertical correction when you are advancing a horizontal muscle and I should try to avoid such a mixed action.

SCLEROCORNEAL TREPHINING FOR GLAUCOMA. COMPLICATIONS AND FAILURES IN ONE HUNDRED CASES.

ALEX. QUACKENBOSS, M.D.,

Boston, Mass.

The object of this paper is to report briefly a series of cases that have come under the care of the staff of the Massachusetts Charitable Eye and Ear Infirmary. With few exceptions they were infirmary patients and include those operated on by Colonel Elliot during his recent visit to this country.

I propose to consider the operation, complications met with, and the failures that have come under my observation. It is too early to pass judgment on the final result of the operation.

The operation has been performed on the following types of glaucoma: acute, hemorrhagic, secondary to trauma, congenital and chronic. Among the chronic cases was a cataract case in which there had been a removal of the lens in capsule. The case was seen fourteen months after the cataract extraction; there was marked cupping of the disc; the tension was 40 mm.; and the vision was $\frac{20}{40}$. The operation was performed successfully and the tension was reduced to 17 mm. One of the "traumatic" cases turned out to be a sarcoma of the choroid.

Three of the cases were operated on twice. One was a sarcoma of the choroid, the second was one of hemorrhagic glaucoma and came to enucleation, the third was of the chronic inflammatory type and the second operation failed to give relief.

A local anesthetic was generally used and a solution of adrenalin was employed to stop the bleeding.

The majority of the operations were performed after the method of Colonel Elliot; the instruments used were the trephines of Elliot, Stephenson and Verhoeff.

Different sized trephines were tried, but the one 2 mm. in diameter was the one of choice. In using Stephenson's trephine I found that an elastic band twisted around the handle prevented the tendency of the fingers to slip off.

In dissecting up the conjunctiva it was buttonholed twice, but in neither case was there any ill effect. By using curved scissors with a blunt point I found that the conjunctiva could be quickly and easily dissected from the cornea.

"Thinning" of the sclera is a condition which must be taken into consideration; in a case of simple chronic glaucoma it was difficult to trephine on this account, and, in a case of buphthalmos in which the eye was enlarged in all directions, the sclera thin and bluish, and the iris tremulous, the operation was abandoned.

In the great majority of cases the trephine button was removed with the aid of scissors; in a few cases the button came out on removal of the trephine, but in no instance did the button fall into the anterior chamber.

The iris usually presented at the trephine opening so that it was comparatively easy to do an iridectomy; but whether the iris presents or not, I believe that if possible an iridectomy should be done in every case. The following cases illustrate the possibility of the iris being caught in, or forced through the trephine opening:

Case, male, seventy-five years of age. Simple chronic glaucoma. At the time of operation there was difficulty in removing the trephine button so that an iridectomy was not done. Four days after the operation the iris was caught in the trephine hole. Ten days later there was no apparent plugging of the scleral opening and the tension was 17 mm.

Case, female, sixty-eight years of age. Simple chronic glaucoma. Following the removal of the trephine button there was no tendency of the iris to prolapse, so only a very small piece of iris was removed. The patient was discharged from the hospital at the end of ten days with a good round pupil. On her return to the clinic at the end of nine days, the pupil was drawn up and there was a prolapse of the iris through the trephine opening. The eye was quiet and there was no increase of tension. The prolapse gradually flattened down to one side, leaving the opening perfectly free. This patient while in the hospital caught cold, and after going home had severe attacks of coughing. It is rather suggestive that during one of these attacks the iris was forced through the opening.

In a case of absolute glaucoma the iris was entirely removed while attempting an iridectomy. The case came to enucleation.

There was a loss of vitreous in three cases, but the amount was small in each case and in no way interfered with the success of the operation.

I believe that the conjunctival flap should be held in place by a single suture, as there is a tendency for the flap to curl up. In one case the suture pulled out on the first day and the conjunctival flap was displaced, but a fresh suture was applied and the case went on without incident.

Following the operation there was very little reaction in most of the cases; quiet iritis occurred in a few cases, and this is the principal danger to be guarded against immediately after the operation. In two cases of simple chronic glaucoma there was a severe iridocyclitis, resulting in grave damage to the eye. One was in a woman of forty-eight with normal

central vision and a tension of 50 mm. There was some reaction following the operation and the anterior chamber was slow in filling. At the end of four months there was a conjunctival bleb with a good scleral opening, but there was a good deal of exudate in the pupillary space and the vision was reduced to $\frac{2}{10}$. The tension was normal. The other was in a woman of seventy-three, and the operation was followed by marked inflammatory reaction resulting in exudate on the capsule and opacity of the lens. The anterior chamber was six weeks in reforming.

This late reëstablishment of the anterior chamber may increase the tendency to iritis, yet in another case six weeks elapsed before the anterior chamber was formed, and there was no reaction whatsoever. This case was interesting from two points—first, the age of the young man, seventeen, and I suppose could be classified under the head of congenital glaucoma; second, the marked cupping of the optic discs; there was at least eight diopters of cupping in the left eye. The anterior chamber was normal and the tension 47 mm. It was six weeks before the reëstablishment of the anterior chamber but at no time was there any inflammatory signs. The tension was reduced to 23 mm. The right eye showed the same condition, but not so far advanced, and was operated on successfully.

I am not prepared to say whether atropin should be used as a routine measure on the second or third day; my practice had been to use it only in the cases showing signs of inflammation.

Persistent low tension has occurred in only one case, that of a man, forty-six years of age, with simple chronic glaucoma. There had been a previous iridectomy in each eye. The recovery from the trephine operation was uneventful. Five months after the operation the tension was 10 mm., and the vision 0.7, a little better than before the operation.

Another condition—separation of the choroid —was seen.

Case, male, seventy-two years of age. Simple chronic glaucoma o. u.

V. R. E. $\frac{10}{200}$ — 3 sph. = $\frac{20}{50}$ Tension 40 mm.

V. L. E. $\frac{10}{200}$ — 3 sph. = $\frac{20}{200}$ Tension 44 mm.

Deep anterior chamber, pupils normal size, sclerosis of lens, marked cupping of discs, nasal contraction of field. Trephine operation on each eye, one week apart, healing normal. Previous to discharge from the hospital, examination of the fundi revealed a vertical separation of the choroid of each eye. In the right eye it was on the temporal side; in the left, on the nasal side. It is impossible to say how long this condition persisted as the patient lived at a distance. Three months later the separation had disappeared and the vision was slightly better than before the operation. Tension, R. E., 27 mm.; L. E., 30 mm.

Late infection occurred in one case. If time adds to the number of reported infections through the conjunctival bleb it will be a serious drawback to the operation. I consider this the only real danger to be feared from the operation.

Case, female, seventy-five years of age. Simple chronic glaucoma o. u. Under observation and pilocarpin treatment for seven years. Gradual failure of sight and contraction of nasal field. Tension increased, nerve cupped. Both eyes operated on in September, 1913; good recovery, no inflammation, no atropin used. One month after operation there was a conjunctival bleb and good scleral opening. Five months after the operation there was an attack of acute conjunctivitis in the right eye; when seen the anterior chamber was filled with pus, panophthalmitis ensued, and at present there is beginning phthisis bulbi.

The following cases were not relieved by operation:

Case, female, seventy-one years of age. Acute glaucoma complicated with trachoma, with involvement of cornea of right eye. Vision, fingers at one foot; eye injected; tension 68 mm.; shallow anterior chamber. Operation under ether; trephine with iridectomy. One month later patient returned on account of pain. Tension up and opening apparently closed. Under ether an iridectomy was done

and the eye gradually quieted down without any improvement in sight.

Case, male, fifty-seven years of age. Chronic inflammatory glaucoma L. E. Duration, two years; past two weeks painful and inflamed; eye injected; cornea steamy, anterior chamber normal, pupil moderately dilated, fundus not seen. Tension 80 mm. Two operations without relief. Tension remained up, 70 mm.; eye red and painful three months after second operation. No cause assigned for failure of operation.

Case, female, fifty-one years of age. Chronic inflammatory glaucoma R. E. Eye injected; anterior chamber shallow; pupil small; tension +2. Operation apparently successful; six weeks later return of acute symptoms; eye injected and painful; tension up; there was a conjunctival bleb and there seemed to be a good opening through sclera. Under pilocarpin the eye quieted down.

Among the cases that came to enucleation was one of sarcoma of the choroid, and I include it in this paper because there was a distinct history of trauma. From a clinical standpoint it was considered a glaucoma secondary to injury; it was treated as such, and the real nature of the case was not made out until an examination in the laboratory.

Case, male, fifty-two years of age. Glaucoma secondary to trauma L. E. Three years ago struck in eye with a stick; one year ago vision began to fail. Two weeks eye painful; vision shadows; eye injected; cornea hazy, pupil widely dilated, fundus not seen; tension 56 mm. Iridectomy; no relief; ten days later trephine; eye still painful; sixteen days later second trephine, no relief; enucleation in two weeks. Laboratory report: Sarcoma of the choroid.

Case, female, seventy years of age. Hemorrhagic glaucoma. One year failing sight; pain; injection; cornea hazy; anterior chamber shallow, pupil dilated, fundus not seen; tension +2. Trephine operation without incident; five days later marked increase in tension; pain; hemorrhage filling anterior chamber. Enucleation twenty-five days

after operation. Laboratory report: Hemorrhagic glaucoma; hemorrhages in retina; obstruction central vein; cornea stained by blood-pigment; hernia of lens into corneoscleral opening.

Case, male. Absolute glaucoma; eye injected; cornea roughened; iris discolored; anterior chamber shallow; pupil moderately dilated, lens opaque; tension 53 mm. Trephine operation. In attempting to do an iridectomy the entire iris was pulled out. Enucleation seven days later. Laboratory report: Hemorrhagic glaucoma; obstruction of central vein.

Case, male, fifty-four years of age. Chronic inflammatory glaucoma L. E. Acute symptoms, two weeks' duration; eye inflamed; cornea hazy; iris discolored; pupil moderately dilated; fundus not seen; vision shadows; tension 55 mm. Operation under ether without incident. Following the operation considerable reaction; chemosis of conjunctiva; exudate in anterior chamber. This gradually cleared up, but the eye remained painful; tension 43 mm. Enucleation 21 days after operation. Laboratory report: Episcleral tissue thickened and inflamed, adherent to sclera, preventing filtration of fluid. The scleral opening was patent; hemorrhagic glaucoma.

Case, male, sixty-two years of age. Chronic inflammatory glaucoma R. E. Sight failing several years; vision shadows; eye injected; cornea cloudy; anterior chamber shallow; pupil widely dilated, fundus not seen, tension increased. The eye was removed twenty-six days after the trephine operation on account of pain. Laboratory report: Choroidal hemorrhage.

Case, male, fifty-two years of age. Hemorrhagic glaucoma. In this case an acute attack of glaucoma developed while the patient was under observation. Examination of the fundus showed thrombosis of one of the retinal veins with numerous hemorrhages in the retina. Two trephine operations without success; the eye was enucleated at the end of six weeks. Laboratory report: (Through an error the eye was placed in a wrong solution and it is doubtful if a satisfactory report can be obtained.)

Leaving out of consideration the case of sarcoma of the choroid and that of choroidal hemorrhage, it is worthy of note that the cases that came to enucleation were of the hemorrhagic type. This result gives little hope that the operation will prove successful in this form of glaucoma. It also shows that choroidal hemorrhage may occur.

In two of these cases there was mechanical obstruction to the outflow of fluid—one by the tying down of the episcleral tissue about the trephine opening, and the other by a hernia of the lens.

I wish to add one case to this list. It shows an accident that may happen during the operation and result in blocking the scleral opening.

The eye was blind at the time of operation and the operation was performed in an attempt to retain the eye.

Case, female, forty-eight years of age. History of attack of acute glaucoma two and one-half years ago, untreated. Seven months ago eye painful; inflamed; tension +3. Trephine operation. On entrance to the infirmary the eye was injected and painful; the anterior chamber shallow; pupil dilated; lens partly opaque; vision *nil.* Enucleation. Laboratory record: There is a break in the lens capsule just beneath the scleral opening and the opening is blocked by lens matter; lens partly dislocated. The lens was apparently injured at the time of operation.

Conclusions: The operation is best adapted for cases of simple chronic glaucoma. It is not difficult and can be performed with little danger. An iridectomy should be done if possible. The conjunctival flap should be sutured and a sharp watch should be kept for iritis. Late infection is a serious danger.

TREPHINE OPERATION FOR GLAUCOMA—LATE INFECTION FROM AN ACUTE CONJUNCTIVITIS.

MYLES STANDISH, M.D.,
Boston, Mass.

The failure of an iridectomy to permanently reduce the tension and stay the process of a chronic glaucoma in a large percentage of the cases has made ophthalmologists eager to adopt any new operative procedure which promises to produce a permanent reduction of abnormal tension.

At present the sclerocorneal trephine operation is on trial. The operation itself is not difficult, and, when a proper iridectomy is done through the opening, the result in most of the cases, so far as we can now see, is a permanent reduction of the tension. There is no immediate falling off of vision as so often happens after an iridectomy done through a corneal section. It was also hoped that the trephine operation might be a safer procedure in hemorrhagic glaucoma. This, however, as far as the results Dr. Quackenboss has compiled at the Massachusetts Charitable Eye and Ear Infirmary, does not seem to be correct.

Granted that the establishment of a permanent opening through the sclera produces a permanent reduction of abnormal tension, do the changed conditions produced by this opening, and a constant flow of aqueous through it from within the globe into the loose tissues under the conjunctiva bring with it any secondary changes or dangers to the integrity of the eye?

It is conceivable that this flow may stimulate an increased secretion of aqueous and that with this increased amount of secretion changes may be produced in the chemical com-

position of the aqueous itself to the detriment of the health of the lens and vitreous. Possibly increased activity of the ciliary body may produce secondary changes in that structure itself and the iris. The opening itself may endanger the eye by acting as a route of entrance for infection, or foreign bodies from without.

All of these questions we must wait for time and experience to answer, and it becomes the duty of all operators and observers to make careful note and prompt report upon all cases which tend to establish any secondary dangers resulting from this new procedure.

For these reasons, I wish to report as a matter of record the following case:

The patient was a man seventy-seven years of age who was first seen by me March 29, 1912. He had already lost vision of the right eye with chronic glaucoma. In the left eye he had a vision of $\frac{20}{30}$. The nerve was pale and there was a deep depression which did not occupy the whole area of the disc. Tension + 1. Under a myotic, vision increased to $\frac{20}{20}$ and remained practically the same until April, 1913, when it suddenly fell off to $\frac{20}{40}$. He had lost a sector of the field, and the strength of the myotic was increased. Vision remained practically the same until December, 1913, when he returned without my having seen him for three months. I found the vision to be $\frac{20}{100}$.

On December 17, 1913, I did a trephine operation under holocain. The trephine button did not come out entire, and was picked up on a sharp hook and cut off, leaving a round, clear opening. The iris promptly presented in the wound and an iridectomy was done. The anterior chamber was rather slow in establishing. On January 9, vision was $\frac{20}{100}$. The tension resulting was normal.

The patient was not again seen by me until the 26th of February, when he reappeared at my office, and said that five days before he had retired with his eye as well as ever, and woke in the morning with lids stuck together; since then the eye had been much inflamed and was then worse than it had been. There was present an abundance of mucopurulent

discharge, and much congestion of the conjunctiva, and the bleb over the trephine opening was of considerable size and filled with a solid yellow mass. There was a distinct hypopyon in the anterior chamber. The infection of the conjunctiva and the hypopyon disappeared in about ten days under treatment. The anterior chamber became very shallow, and a low form of iritis came on during this period, which caused several synechiæ that I was unable to break down, and there were deposits on the anterior and posterior capsules of the lens. The lens itself lost something of its clearness. The iritis promptly ceased under treatment, and since then the opacities on the lens capsules have steadily diminished, but the opacities which remain, taken in connection with the slight disturbances of the lens structure, have reduced vision so greatly that it is with difficulty the patient finds his way about. Tension remains normal.

It is evident that the presence of a subconjunctival opening into the globe may furnish the route for an intraocular infection when an acute conjunctivitis occurs. This possibility must always be considered when choosing an operation for glaucoma, and would seem to be sufficient reason for not selecting the trephine operation in acute glaucoma where the ordinary iridectomy offers a good chance of a successful result.

It also makes the presence of even a small amount of disturbance of the lacrimal drainage apparatus a condition to be treated seriously. Whether such cases are to be exceptional remains to be seen.

There is some hope that this may be the case from the fact that the number of infections following the ordinary iridectomy in glaucoma have at the hands of all operators been excessively small. This I have always supposed to be due to the constant outward flow of the aqueous, yet it may be that the difference in the conditions between an open corneal wound and a scleral wound covered by conjunctiva may be such as to greatly change the liability to infection.

My conclusion from this case is that the danger of an intraocular infection from an acute conjunctivitis is sufficient to compel us to warn all such patients that any conjunctival disturbance is to be taken seriously, and promptly treated, or disastrous results may supervene in a case in which a trephine operation has been done.

DISCUSSION OF PAPERS OF DRS. QUACKENBOSS AND STANDISH.

DR. G. E. DE SCHWEINITZ, Philadelphia: In the presence of persisting increased intracranial tension choked disc frequently develops. A technically correct cerebral decompression which releases this increased intracranial tension in many instances is followed by a subsidence of the papilledema and preservation of vision. In the presence of persisting increased intraocular tension the complex disturbance of function and structure called glaucoma develops. A technically correct operation which releases this increased intraocular tension is frequently followed by the subsidence of the glaucomatous symptoms, and preservation of vision is secured. The release of intracranial pressure as the result of a cerebral decompression is not always followed by the disappearance of the disc edema, and vision is not always saved. A technically correct operation which releases the intraocular pressure is not always followed by a subsidence of the glaucomatous symptoms, and sight is not always saved. Increased intracranial pressure is not the whole story of choked disc; neither is increased intraocular pressure the whole story of glaucoma. A certain analogy exists between these operative procedures, each endeavoring in its own way to release from activity the most potent factor which is disturbing cerebral and ocular function on the one hand and ocular function and structure on the other hand.

For years it has been known that if a filtering scar followed the ordinary operation for the relief of glaucoma, namely, iridectomy, the prolongation of the good effects of the operation, provided no other complication arose as the result of this filtering scar, was better than when there was neat and perfect healing of the wound. Therefore it has seemed to many surgeons, notably to Fergus, Elliot and Lagrange,

that if a safe filtering scar could be produced this much-desired end would be accomplished. At present the majority of operators apparently believe that the Elliot technic is more apt to be followed by success and with less danger to the eye than any of the other procedures thus far described and perfected, and it is a fact that most operating surgeons can point to satisfactory continuous drainage which has lasted for several years.

My experience with Colonel Elliot's operation is limited, and comprises about thirty operations. Of the various types of glaucoma which have been submitted to this operative procedure, and which have been under my own personal observation, I may include the following: Absolute glaucoma secondary to intraocular hemorrhage; postoperative glaucoma—that is, glaucoma after extraction of cataract; glaucoma secondary to cataract—that is, in association with the swelling of a cataractous lens; acute glaucoma; ordinary chronic glaucoma; chronic glaucoma with exacerbations, sometimes called subacute glaucoma or chronic congestive glaucoma, the "glaucoma irritatif" of de Wecker; corneal lesions with glaucoma—for example, staphyloma; absolute glaucoma—that is, the end stage of either a recurring congestive glaucoma or an acute glaucoma. The technic of all of these operations was that described by Colonel Elliot, as nearly as one can learn an operation from a written description. Since his visit to this country, so far as I am aware, the technic has exactly followed that which he advocates. In all instances except one the Stephenson trephine was used; once only the von Hippel trephine was employed, and I shall not again use it.

I have never seen in my own experience an extensive hemorrhage into the anterior chamber, or the entrance of the scleral button into the anterior chamber. Perhaps this is a commentary on my technic, as it is said never to occur except where the trephining has been unusually correct. I have never observed a purulent infection, either primarily or at long periods after the operation has been performed, in any patient of my own, although I have seen an infection a month or six weeks after trephining at the hands of another surgeon, the patient having come into one of my hospital services. Iritis after this operation occurs with irritating

frequency (even Colonel Elliot admits this) and appears either as a quiet iritis, with almost no signs of inflammation of the uveal tract, but with the gradual development of soft synechia, very much as they occur in the so-called uveite irienne of Grandclement, with lesions confined to the posterior layer of the iris, or as a sharp, ordinary plastic iritis which may arise at longer or shorter intervals after the eye has forgotten the effect of the operation, to use Mr. Carter's expression.

What causes this quiet iritis? I do not think that any satisfactory explanation has been given. It certainly is not an infection in the ordinary sense of that term. It may be due to some change which takes place in the iris tissue as the result of long-continued reduction of tension, some disturbance of tissue metabolism, perhaps due to some toxic property which the aqueous humor begets. It is not necessary to assume that this complication must occur in every case, because we all know that a number of tissues of apparently exactly similar composition may be exposed to similar toxins, and one tissue become involved in one subject and the same tissue in another subject escape. We are rather ignorant in regard to the processes of detoxication. This much seems to me to be definitely necessary, namely: That unless the pupil is dilated, as Colonel Elliot says, the very early use of mydriatics should be insisted upon. He uses atropin. I have preferred scopolamin or homatropin. Now the later types of iritis, more plastic in type, seem to me exactly analogous to those which we used to call tenth-day iritis after cataract extraction, and which are unquestionably infections caused by the sucking in through the filtering scars of contaminated conjunctival juices, for it is not necessary that a purulent material should form in each infection. All postoperative iritis of this character belongs to some type of infection. I have never observed intraocular hemorrhage or detachment of the choroid.

Summarizing my experience with this operation, derived in part from my own operative work and in part from the operative work of colleagues here and abroad, I may record it as follows: I am unconvinced that corneoscleral trephining is a better operation in acute primary glaucoma than a technically correct iridectomy; I am convinced that it is a

better operation in ordinary chronic so-called non-inflammatory glaucoma than the usual iridectomy, and that if an iridectomy in this disease has failed of its purpose, it is a wise operative procedure in place of a second iridectomy or a sclerotomy; in chronic glaucoma, with greatly contracted visual field, it appears to me to be a safer procedure than ordinary iridectomy, which so often has been followed in these circumstances by a rapid obliteration of this much contracted field; it is not a wise operative procedure if glaucoma is complicated with cataract; it is an operative procedure which should be thought of and in most instances practised in glaucoma secondary to cataract extraction, at least in those eyes in which the vitreous and aqueous chambers are not in communication; it is a proper operation in absolute glaucoma; and, moreover, it may be repeated in the hope of preventing enucleation, although it can by no means be definitely promised that this prevention is assured; it does not seem to be an operation that is likely to meet with success in increased intraocular tension due to intraocular hemorrhage, thrombosis of the central vein of the retina, and blindness as the result of this type of glaucoma; it is an operation that may be tried in staphyloma and secondary glaucoma, but the outlook is not a brilliant one.

A serious objection to the operation is the frequency of iritis of both types, and it has seemed to me that the plastic type of iritis is more apt to occur in those patients who are liable to the so-called autotoxemic forms of uveitis and iridocyclitis, types which used to be classified as rheumatic and gouty iritis. The early type of iritis, quiet in its manifestations, should be guarded against, as Colonel Elliot advises, by the early use of mydriatics—in my experience, preferably scopolamin or homatropin. I make no further reference to delayed formation of the anterior chamber, to misplacing and buttonholing of the conjunctival flap, and specially to late infections, as they have recently been so elaborately described by various authors. If, as I said in the beginning, the whole story of glaucoma was increased intraocular tension, then this operation, or any other successful operation which induces permanent filtration, would come close to being the last word in the treatment of glaucoma, but I do not believe that increased intraocular ten-

sion is the sum and substance of this difficult and complex disease, and I am convinced that in its treatment, in addition to operative procedures, the very best line of therapeutics, suggested by elaborate studies of metabolism and with the aid of an expert internist, is required.

In conclusion, I would like to say that the judgment of the value of this operation, or, indeed, of any other operation designed for the purpose of checking the ravages of glaucoma, should not be based alone upon the estimations of the reduction of intraocular tension, important as this matter is. Rather it seems to me that the preservation and the restoration and the improvement of visual acuteness, and the widening of the field of vision, should be given prominent place as standards in the estimation of its efficiency. It seems to me also that more accurate studies should be made in regard to the relationship of plus tension of an eyeball to the health of that organ than have thus far been put upon record, exactly as the clinicians have learned that arbitrary standards of vascular pressure cannot be set up, and that frequently there may be what Hobart Hare calls a pathological norm in arterial pressure which it is unwise to disturb. Dangerous as increased intraocular pressure is to the health of an eyeball, I suspect that we should, praiseworthy as our efforts are to get rid of such pressure, be careful that we do not originate another danger, to wit: the creation of pathological changes brought about by too long-continued hypotony.

DR. ALLEN GREENWOOD, Boston, Mass.: I happen to be the unfortunate who had the case of late infection and panophthalmitis reported by Dr. Quackenboss. I operated on both eyes with a 1½ mm. trephine. I have used that size almost exclusively, and I find that I can do a complete iridectomy through the opening, though in one or two cases I have used the 2 mm. trephine. In this case the right, or nearly blind, eye was operated on first in order to test the patient's condition and the ability of the eye to withstand the procedure. The bleb, in that case, over the trephine opening was one of those very transparent looking blisters, and I think that cases like this, with very thin conjunctivæ, are the ones in which an after-conjunctivitis may cause

some infection, and in which there is the greatest probability of late infection. Such patients must be watched with great care. In this case, five months after operations on both eyes, which kept the vision where it was prior to the operations, the patient developed acute conjunctivitis and panophthalmitis, and now has phthisis bulbi in the first eye. The second eye retains today its postoperative vision.

DR. LUCIEN HOWE, Buffalo, N. Y.: While this subject is under discussion, I wish to mention that, as many members are doubtless aware, this principle is by no means as new as it seems. I thought it worth while to bring here a trephine which I have had for twenty years or more. It is simply to remind those who do not remember the literature that we have gone over this subject quite thoroughly already. I shall not attempt to go into the details of the earlier method, but it once came into vogue, and, though it had some advantages, they seem to have been partly forgotten.

DR. WALTER L. PYLE, Philadelphia: I am in thorough agreement with Dr. de Schweinitz, that increased intraocular tension is not the whole of glaucoma; and I also believe that there should be a modification of the present enthusiastic recommendation of these simpler operations for eyeballs that show persistent increased tension. For fifteen years I have practised massage in so-called cases of "chronic glaucoma," with hard eyeballs. I found, early, that there were two types of cases: (1) Eyeballs that could not be affected with a few seconds' massage and; (2) eyeballs that softened quickly under my fingers. On patients of the latter class I do not operate. I have taught such patients to massage their own eyeballs and to use weak solutions of myotics, and have yet to find one patient who has suffered serious damage of vision. If you apply a tonometer to such eyeballs, you find at first evidence of increased tension, but this diminishes within a few seconds, from the pressure of the instrument alone. Any eyeball with persistently high tension will show blurring of the optic nerve-head and retina, and exhibit contracted fields. Sometimes after massage of the eyeball the visual fields will widen and the acuity and quality of vision increase. In such cases, I certainly should not operate.

I hope the fact that we have safer operations for the reduction of intraocular tension will not influence the ophthalmologists to operate in such cases, without first trying massage and observing the results. I do not really use massage; I simply press the eyeball by alternate palpation with the finger tips. If the tension diminishes, I postpone operation. When in any doubt, I take the fields, both on dull and bright days and when the patient feels badly and fairly well, and compare the results.

DR. S. LEWIS ZIEGLER, Philadelphia: Dr. Quackenboss spoke of the incision which Colonel Elliot recommends and of the question of using a suture. I think, on general principles, that we ought to introduce a suture in every operative wound of this character and especially in any conjunctival wound. The incision that Colonel Elliot has recently recommended is much higher than his old incision. I will pass around a copy of the cut that was submitted to Colonel Elliot for his approval, which shows the incision to be much higher than has been shown in most of the illustrations that have been made.

This question of plastic iritis occurring in late closure of the wound is a very important one, and is difficult to explain. It occurs as well in the Lagrange operation, of which I had a case that I punched out the sclera and had a beautiful result with no reaction, but there was a marked plastic exudate on the lens of one eye, which did not begin to absorb until the wound closed. I showed Colonel Elliot a case in which I had done his trephine operation on one eye and an iridectomy on the other. In the latter, I had no exudate; but in the trephined eye, there was a marked one. This again was a case of delayed healing of the wound.

As to guarding against late infection, chiefly from conjunctivitis, I think this is difficult to accomplish. If we have a breach in the scleral structure, with nothing but conjunctiva over it, there is always the possibility of infection of the eye from an attack of conjunctivitis. I recently saw a case in which trephining had been done two years before with a good result. You could see that the infection had occurred through the scleral opening. It was not a serious infection, but there was a marked hypopyon.

In this connection, I should like to show a small trephine that I have devised. It has the bevelled handle which Colonel Elliot prefers, and a reverse bevel above. It is a dumb-bell shaped handle. Your fingers cannot slip either way. Many put their fingers on top of the trephine, so I have left a sharp point there to remind operators that it should not be used in that way. If you will take it between the thumb and forefinger held in line with the shaft and twirl it, it will work nicely and make a good incision. There is a small opening left for cleansing purposes.

I think that we ought to give some credit to one of the oldest members of this Society, and a man who was very prominently associated with us at one time. I refer to Dr. George Strawbridge, of Philadelphia, who, when I was interne at the Wills Eye Hospital, trephined many scleras, not only for glaucoma, but as a perforation for an artificial pupil and for other purposes. He performed at least fifty such operations in the hospital from 1887 to 1889. I think that these cases were placed on record somewhere. I tried to find them in our Transactions, but could not locate them. I think he said that they were on record there.

In many of these hemorrhagic cases, it is not always possible to trephine and avoid hemorrhage. I formerly thought that a posterior sclerotomy was the safest procedure when there was a danger of hemorrhage. I operated recently on a case with a tension of 110 mm., by means of posterior sclerotomy, with no relief. There was a small intraocular hemorrhage and a bulging of the wound, and the tension was not reduced. I then did a cyclodialysis, which gave prompt relief. We measured immediately after the operation and found a tension of 47 mm. The next day it was 17 mm. The following day it went down to 5 mm. but returned to 17 mm. on the third day, where it has since remained. The patient now has a quiet eye. I made the incision for cyclodialysis on the bevel, so that there was no wound of any consequence exposed on the surface of the eyeball.

Dr. Pyle referred to massage as a means of temporary relief. I think that we should also consider negative galvanism, which will reduce the tension promptly, and hold it down for a short time. The remedy that I rely on most,

however, is a hypodermic injection composed of hyoscin, pilocarpin, morphin, and strychnin. This, by its action, controls the tension through the system. It stops the hypersecretion in cases in which you would instill eserin in the eye. Hyoscin is the most active agent of the combination and will cause a reduction of the tension when injected into the body; although locally, it will, of course, increase the tension. It is important to remember, in cases of fulminating glaucoma, that we have such an efficient remedy to fall back on.

DR. BROWN PUSEY, Chicago, Ill.: Dr. Quackenboss speaks of a hernia of the lens in one of his cases. I happen to have a specimen from the practice of Dr. C. D. Wescott in which this condition exists. I believe that it would be possible, in such cases, to relieve the glaucoma by a second operation.

DR. WEEKS, New York: At this stage of the employment of the operation, it seems to me that it is wise to have as full discussion of personal experiences with the operation as possible. I have operated by the Elliot method on perhaps twenty-five or thirty cases. The occurrence of iritis has been very little in my experience. In fact, I have had only one case, and that not severe. I have not had any infection of the eye. I have had one case of hemorrhage in a patient with a tension of thirty-seven before operation. The hemorrhage occurred about thirty hours after the operation. The eye was at rest and the tension about normal up to this time. The patient elected to take a general anesthetic. She had some nausea and vomiting. When the hemorrhage occurred, the tension went up and became quite high. I did not measure it with the tonometer. It is now four weeks since the operation. The retina is pushed forward at the temporal side. The patient can count fingers at about three feet. The tension is normal or subnormal, and the eye is in good condition.

I should like to raise the question with regard to the size of the trephine opening. I have seen three cases in the practice of others in which the lens was pushed forward into the opening, and have seen microscopical sections of two other cases; and it has occurred to me that the trephine

opening is sometimes larger than is necessary. The larger the opening, the more danger there is of pushing the intraocular tissues into the opening. I have used the 1 mm., the 1½ mm. and the 2 mm. trephine, and have obtained the best results with the 1½ mm. It seems to be large enough to permit of the removal of a good piece of iris, and the effect on tension has been satisfactory. I should like to hear an expression of opinion as to the size of trephine most desirable.

Regarding the suture, I have used sutures in all but two or three cases, and do not regret having done so. I feel that it is safer to use the suture. I have not had any post-operative infection.

I want to express my gratification at having heard the very excellent discussion on this subject by Dr. de Schweinitz. I agree with him fully that the infections that he describes are much as he has said. In the early cases, where the iris is bound down, it seems likely that a change in the aqueous has much to do with it. In the later cases, it probably comes from endogenous or exogenous infection.

DR. E. C. ELLETT, Memphis, Tenn: There is one angle from which this subject has not been viewed, and that is the question of just what occurs in the healing of the trephine opening. One of the gentlemen spoke of establishing a permanent opening in the sclera. I am somewhat embarrassed to know how much to say about this, because I have done some work for presentation at the meeting of the American Medical Association next month, and do not want to say much in advance of that. What I want to say has to do, however, with the results of my own observations which were experimental, as well as with two other studies by Kummel, of Erlangen, and Du Camp, of Paris. All these observations are to the effect that unless there is a prolapse of the iris or ciliary body, these wounds heal over, so that in the course of time it is impossible to distinguish the trephine opening under the microscope. The regeneration of tissue is apparently perfect, and it is difficult to understand, by looking at these sections covering the changes from the time of operation to the end of the eighth week, when healing is complete, how any sort of filtration or escape

of aqueous humor can occur other than what occurs through normal sclera. In closing his discussion at the International Congress last summer, Colonel Elliot said that he believed the majority of his cases were fistulized. In operating on eyes in which there is no increase of tension, fistulization occurs very rarely. In a considerable number of specimens, I have not found it at all. Aside from the clinical results, about which there does not seem to any question, it is hard to see how this operation brings about the permanent reduction of tension that it does.

DR. SAMUEL THEOBALD, Baltimore, Md.: It seems to me that one point is pretty clear, at least, it is so in my mind, that in inflammatory glaucoma we obtain satisfactory results from iridectomy. In simple glaucoma we know that this is not true. The outcome of an iridectomy in pure simple glaucoma is, as a rule, unsatisfactory. As I reason it out, there seems to be little warrant for using Elliot's method in cases of inflammatory glaucoma. In the first place, it is more difficult than in glaucoma simplex, for the parts are congested, and there is considerable hemorrhage. I should have no inclination to resort to the trephine operation in such cases, but I have in simple cases. So far my experience has been confined to watching cases of glaucoma operated on with the trephine by other men. I have had but one case which seemed suited to the employment of the trephine; and in that, the instrument was not in a condition to operate with.

Another point that has occurred to me is that I can see no advantage in making a triangular peripheral cut in the iris instead of doing a complete iridectomy. Why not have the trephine operation plus the iridectomy? In the operations that I saw done by Elliot, there was more inflammatory reaction following the trephine operation than one sees following iridectomy in glaucoma simplex; and there seemed to be inflammation of the iris in the neighborhood of the partial iridectomy. We should make an iridectomy down through the pupillary margin, and limit the trephine operation to glaucoma simplex, employing it only as a last resort in inflammatory glaucoma.

I want to show a trephine that I have devised. There

is only one thing novel about it. Operators seem to have trouble in keeping the trephine at the exact spot where they start the cutting; so I have introduced a central pin, which holds the trephine where you want it. When the cut in the sclera has been well started, the pin can be drawn back, so that it will not endanger the lens or do other harm inside the eye.

Dr. Ziegler and I seem to have the same idea in regard to making the trephine smaller. I cannot see any advantage in the large one that Colonel Elliot uses. The smaller one is easier to manipulate and more delicate. A slight turn of the thumb and finger carries the cutting edge further than is the case with the large trephine. The pin has advantages, and, as has been said, it can be thrown back before the section is completed.

DR. J. M. RAY, Louisville, Ky.: My experience with this operation has been about thirty cases, not enough to base a conclusion on. I have had some little experience in post-operative infection. In the early part of 1912, when the operation first became known in this country, I tried it in a case of acute glaucoma. In one eye an iridectomy had been done a number of years before by the late Dr. Herman Knapp. The patient was a man with between six and seven diopters of hyperopia and a microphthalmic cornea. After the operation by Dr. Knapp, he did well for a number of years and then had increased tension which led to enucleation. He had no trouble with the other eye except a little transient tension, which was controlled for some years by eserin and massage. I was called up by his wife, who told me that he had acute trouble in the remaining eye with symptoms of an acute glaucoma. He was treated with eserin, hot compresses and purges, resulting in slight lessening of tension. On the second day, I did a trephine operation. I had no trouble with the operation except a considerable amount of reaction. This operation was made before I was aware that iritis would develop in these cases so much more readily than after iridectomy. He developed an iritis on the second day, and it seemed impossible to break up all the adhesions. He has useful vision now, with tension that is approximately normal, and a nice filtering bleb.

Since then I have operated on one or two other cases of acute glaucoma; and in one of these it seemed as if the entire end of the ciliary process fell forward into the wound. In a short time, tension was again established and the eye did badly.

I have recently had two cases of late infection. In May of last year I operated on a maiden lady, between sixty-five and seventy years of age. It was a case of subacute glaucoma, and she had a very smooth recovery. Later, about the middle of June, I operated on the second eye, with a resulting iritis, which was controlled by atropin. I went abroad, and while I was away, during the heated summer term, she contracted an acute conjunctivitis. This was followed by infection, the anterior chamber filled with lymph, and it was quite a long time in clearing up. I returned home in September in time to see only the latter end of the case. The patient still had a slight hypopyon. The aqueous was murky, and has cleared up very slowly.

In February, I operated on a case of chronic glaucoma in both eyes. In one eye, six weeks after the operation, with the tension normal, the same thing occurred as in the case of the maiden lady. At first there was just a little opacity. Then streaks of lymph seemed to hang from the trephine opening down into the anterior chamber, in the bottom of which it accumulated.

One other point that I should like to call attention to is the splitting of the cornea, according to Elliot's directions. I used the Stevenson knife and split the cornea, so as to place the trephine opening as far forward as possible. After the operation, the tissue fell back into position and the opening was apparently blocked entirely. You could see the outline of the trephine opening through transparent cornea. There was a small bleb for a while, which over-rode the cornea, but it gradually seemed to fill up, and the tension returned just the same as if nothing had been done.

DR. W. B. LANCASTER, Boston, Mass.: I should like to ask Dr. Ellett whether his observations were made on human eyes or on the eyes of rabbits. In the human eye, there is filtration for many months. The fact that his work was done on the eyes of animals may explain the difference in his results.

I have come to the conclusion that, as Dr. Weeks says, the 1½ mm. trephine is large enough. Another reason for using one of this size is that you can get the hole away from the angle of the anterior chamber better. A 2 mm. trephine requires the cornea to be "split" ½ mm. farther forward than a 1½ mm. trephine in order that in each case the hole may clear the angle of the anterior chamber by the same amount. A larger hole requires a larger space.

In regard to the lens getting into the wound, I think that the commonest way, though not the only way, that this happens is from the lens being injured by the trephine going in too far. The necessity of lifting the trephine at short intervals in order to determine the depth that has been reached, lest inadvertently we penetrate too far, makes it desirable to have a mark of some sort, as, for example, a dark ring put on the instrument about one and a half millimeters from the tip, so that you may see how far in you are going without having to withdraw the trephine. I like this better than any of the guards that I have seen because they project and are in the way.

One complication not mentioned is that of fistula through the conjunctiva. I saw one case of this last week. I had not seen the patient before for six weeks, and then she seemed to be doing very well. She came into the office saying that her eye was not doing so well as formerly and, on using cocaine and applying the probe to the margin of the bleb, I found that there was a small fistula. The edge of the mucous membrane had folded in slightly as it healed, forming a fistula. The tension was below five. I trimmed the edges and sewed them together. I do not know what the final result will be, but I hope that this will relieve the condition of irritability.

DR. W. R. PARKER, Detroit, Mich.: I should like to emphasize one point made by Dr. Quackenboss, regarding the advisability of a complete iridectomy. In my experience, including 27 cases, 83 per cent. in which a small iridectomy or no iridectomy was done showed iritis, while only 20 per cent. in which a complete iridectomy was performed exhibited signs of iritis. The advantage, therefore, was in favor of the complete iridectomy, in the ratio of 20 to 83.

DR. W. H. WILDER, Chicago, Ill.: I have been struck with the great frequency of irritation following this operation, even in the cases done for us in Chicago by Colonel Elliot. This is not necessarily an irritation because of iritis, but it is an irritation of considerable severity. In one of my cases everything about the operation passed off as well as possible, trephining being done in each eye. The result as to tension has been very satisfactory. A small iridectomy was made at the root of the iris, as suggested by Colonel Elliot. For some reason or other, however, whether mechanical or chemical, I do not know, the patient suffered acute pain following the operation and has had attacks of neuralgic pain around the eye for weeks after the operation, although the tension remains normal. Therefore, while I used to say to my patients that their pain would be relieved by the operation, I do not now feel like promising them that they are going to be immediately and entirely relieved of pain. In this particular case the irritation was extreme. There was apparently no iritis, because by use of a mydriatic we at once got dilatation of the pupil; and when the pupil tends to dilate of itself, we can control pain by the use of myotics. The patient has considerable neuralgic pain around the face, and several other patients have complained of pain lasting long after the irritation of the eye had subsided—ten days or two weeks. I wonder whether my experience agrees with that of other members of the Society.

Whether the pain and irritation are due to anything connected with the operation remains to be determined. One possible explanation is the tearing of the fibers of the cornea in attempting to split it. Although he uses an iridectomy knife in some cases, in almost all of those Colonel Elliot did in Chicago (I witnessed about fifteen), he used merely the points of the scissors, gradually splitting the cornea for a millimeter and a half, so as to be sure to get the two millimeter trephine beyond the danger line. Whether such tearing of the cornea has anything to do with producing this irritability of the nerve structures of the eye, remains to be seen. I have thought that it might be wiser to use an iridectomy knife. Elliot thinks there is more danger of buttonholing when this is used. Indeed, I did have buttonholing in one case, but this patient got on splendidly, and finally did as well as any that I have had.

I wish to speak about another point with regard to the mechanics of this operation. It seems that we all want to jump into the arena with some new trephine, but I would concur heartily in the decision of Dr. de Schweinitz never to resort to a mechanical device like the von Hippel for such an operation. It does not seem necessary to have a dental engine, or a brace-and-bitt or auger arrangement, in order to get through the sclera. I think that the simplest form of instrument is the best, and I prefer one that you can remove once in a while, to see where you are going, taking the chance of getting into the same track again.

DR. R. L. RANDOLPH, Baltimore, Md.: It is with much hesitation that I discuss an operation which I have never performed. It is obvious that sclerocorneal trephining lowers intraocular pressure and perhaps keeps it low, but whether we can rely upon the permanency of the result remains to be seen, and I do not believe we can speak with positiveness of the value of this operation for at least two or three years. I view with apprehension the outlook of an eye which presents such a condition at the point of operation. When we bear in mind how invariably pterygia and pingueculæ now and again get red and become the foci of attacks of conjunctivitis it is hard to believe how an eye with an opening into its interior covered by a prominent bleb with constant friction going on between the surface of the bleb and the upper lid and with bacteria everywhere on the conjunctival surface can escape infection for very long, and I have heard nothing in this discussion which leads me to think to the contrary. That iridectomy fails to do in chronic simple glaucoma what it does in the congestive form of the disease we all know, but that it sometimes preserves sight for years is equally true. We are still in the dark about the exact nature of glaucoma, and such contradictions are perplexing to say the least. It looks to me not only from the nature of the operation but from recent reports as though late infection were going to prove the ultimate undoing of this operation.

DR. ROBERT S. LAMB, Washington, D. C.: Regarding the size of the trephine, it has been my experience that if you have a thick subconjunctival tissue, the larger trephine is

preferable. I have had to do a second trephining on some eyes, because the first opening was not sufficient to carry off the fluid. Following that experience, I have been using even a two and a half millimeter trephine in cases in which the subconjunctival tissue is thick.

DR. OSCAR DODD, Chicago, Ill.: I have had an experience with between twenty and twenty-five cases of scleral trephining; and, with the exception of some on which I operated early, before Colonel Elliot had published his final papers describing the operation more minutely, I have had uniformly good results. The cases that were lost at that time were cases of absolute glaucoma; one of them being glaucoma following cataract extraction. I attempted to do the operation above, where the incision had been made for the extraction, and found it very difficult, and I believe that this was the cause of the failure. Where to make the trephining after cataract extraction and after iridectomy is one point which, I believe, has not been taken up in this discussion. I think Colonel Elliot stated, in answer to a question, that the trephining should be done at the same site as the iridectomy. My experience has been that this is very difficult to do. Theoretically, one would think that it would be better not to do the trephining below, because it leaves a bleb that comes above the edge of the lower lid very frequently, and is much more likely to be rubbed and infected than if it were up under the upper lid. If any of the members have had experience in trephining at the site of a prior iridectomy, I should like to hear from them.

DR. ZIEGLER: I might answer Dr. Dodd by saying that I have performed the trephining in that way.

DR. ALEX. QUACKENBOSS, Boston, Mass.: Replying to Dr. Wilder's question regarding pain, I would say that in cases of simple chronic glaucoma, the ones for which I think the operation is indicated, I have not noticed pain to be a feature. In the acute or inflammatory cases the pain was not relieved by the operation.

As to the size of the trephine opening, I would state that I have tried the different sizes of trephines and prefer to use the two millimeter instrument, because I think it is easier to do an iridectomy.

DR. MYLES STANDISH, Boston, Mass.: The case that Dr. Quackenboss reports in which he removed the eye and found the lens injured, it having been dislocated over the opening, was one of my operations. This patient had a chronic glaucoma, which had been either not treated or mistreated for a year or more; and there was an excessive amount of tension—in fact, so much that I got confused in trying to use the tonometer, and put the tension down as + 3 + in my record. The anterior chamber might be considered to be there by courtesy. That is, I suppose that there was aqueous behind the cornea, but the lens was pushed forward against the posterior surface of the cornea. The patient came to me with the idea of having the eye removed on account of the intolerable pain. I had never done a trephine operation but, as it was an eye that I could not harm, I thought that I would try the effect of the operation in this case. The opening was made with the smallest trephine in Dr. Elliot's set, and, I being a novice, used the instrument with great care. Indeed, until the eye was removed by Dr. Quackenboss and the pathologist reported that the lens had been injured, I had no idea that I had touched the lens. It is to be remembered that this patient, although she had pain for some time after the operation, was relieved from pain for five months before the final attack of pain for which the eye was removed. It is possible, therefore, that this dislocation of the lens took place then, rather than at the time of the earlier operation. If the lens had been dislocated when I operated, I could, from its extreme anterior position, have seen the edge of it. The tension was never reduced to normal at any time. Immediately after the operation, the tension was + 1, and I think that the dislocation of the lens was a secondary process to the established drainage.

There is only one thing more of which I wish to speak, and that is the phenomenon that has been called separation or detachment of the choroid. In one of my cases this happened a few days after the operation. I looked into the eye of an elderly man, three days after the operation, and found that I was looking through a tunnel into the depths of the eye. On each side, corresponding to the width of the pupil, there was a detachment of the retina that was

apparently vertical; so that I looked in between two parallel walls. I supposed the case was hopeless and sent the patient home a few days later; but within a week or ten days afterwards, he came back. Looking into the eye, I found, to my surprise, that there was no detachment whatever visible.

REPORT OF A CASE OF DETACHMENT OF THE RETINA OCCURRING IN A CASE OF NEURO-RETINITIS, RELIEVED BY SCLERAL TREPHINING OPERATION, ASSOCIATED WITH INCISION OF THE CHOROID AND RETINA. NO RECURRENCE AFTER A PERIOD OF EIGHT MONTHS.

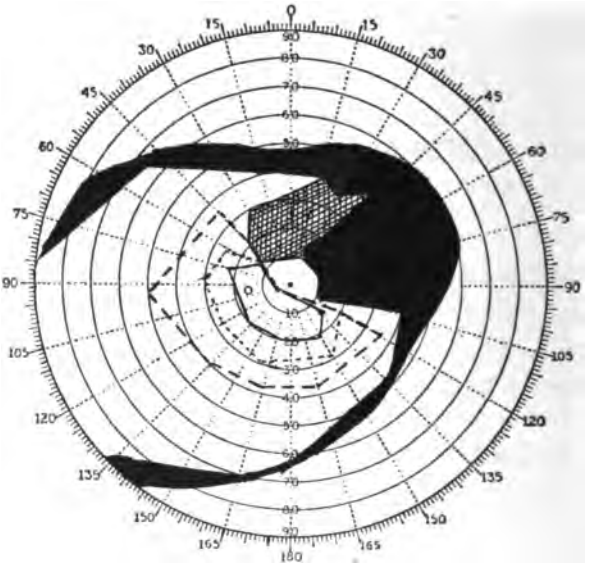
WALTER R. PARKER, M.D.,
Detroit, Michigan.

The case was one of double neuroretinitis of unknown origin, associated with a partial detachment of the retina down and out in the left eye, of one year duration. The sclera was trephined over the site of detachment and an incision made in the choroid and retina. The operation was followed by a free discharge of a straw-colored fluid and a small amount of vitreous. A marked reaction followed, the whole bulbar conjunctiva becoming edematous. After a lapse of ten days the reaction had disappeared and the retina was reattached. No recurrence after a period of eight months. Vision before operation $\frac{4}{60}$; final record $\frac{6}{12}$.

History: The patient, H. H., male, aged forty-six, came to the ophthalmic clinic of the University of Michigan, September 23, 1913, complaining of a progressive loss of vision in the left eye which began one year previously as a crescent-shaped shadow, convexity downward, in the upper part of the visual field. There had been no trauma, no pain or photophobia. The family and personal medical histories were negative.

Examination: R. E., $\frac{6}{6}$; L. E., $\frac{4}{60}$, temporally. Pupillary reflexes were normal; tension normal; no external pathology in either eye.

Ophthalmoscopic examination: Right eye—Some fine and reticular vitreous opacities, otherwise media clear. The physiological depression present; lamina cribrosa show faintly. The disc slightly edematous, scleral ring present, the choroidal ring blurred. The arterial reflex stripe is most conspicuous in the macular vessels. Arteriovenous



Green _____ Red..... Blue _ _ _

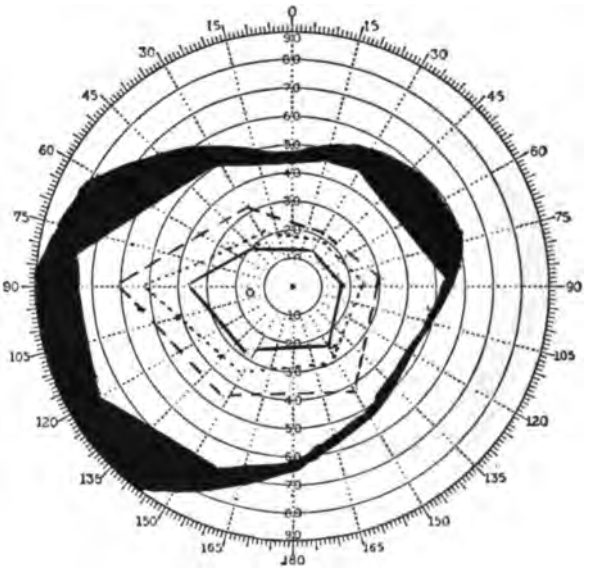
Fig. 1.—Visual Field. Before Operation.

compression with some distal dilation. The foveal reflex is present. Left eye—Innumerable fine dust-like opacities in the vitreous, few larger and rounded, all of the same type, but variable in size. The disc is hyperemic, physiological depression is present, lamina cribrosa faintly seen, scleral and choroidal rings blurred. The arterial reflex stripe is conspicuous. There is a silver wire macular artery nearly developed just about the fovea. The retina about the disc

is hyperemic and swollen; whole retina edematous. Below the fovea the retina is folded and floats free from the choroid. The detachment extends from about one disc diameter below the disc downward and outward as far as can be seen.

Visual field: The field (Fig. 1) showed marked contraction in the superior nasal portion.

Medical examination: The physical examination was negative. Blood-pressure 120, urine negative, except specific



Green _____ Red..... Blue _ _ _ _

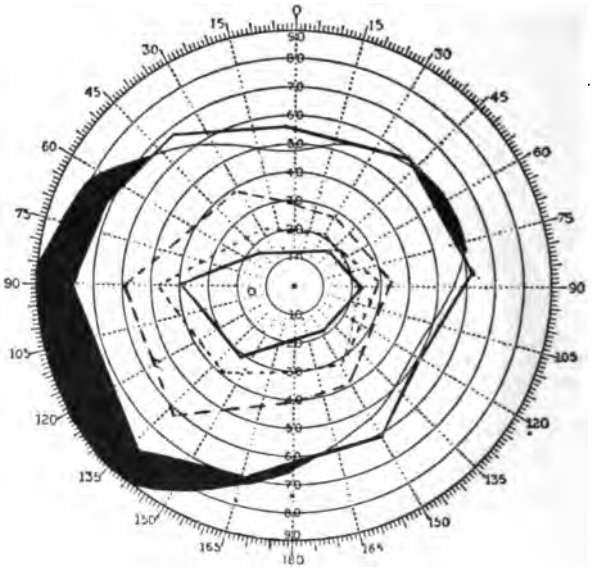
Fig. 2.—Visual Field. Three Weeks After Operation.

gravity, 1007. Wassermann negative. Sinuses negative. Teeth in good condition. Tuberculin test not made.

Diagnosis: Neuroretinitis with detachment of the retina in left eye. Cause not determined.

Operation: October 16, 1913, a flap, including all the tissues overlying the sclera, was made down and out, and with the 1.5 mm. blade of von Hippel's trephine an opening was made through the sclera at a point corresponding to the

retinal detachment. The scleral button was readily removed and was followed by a slight escape of fluid. The choroid and retina were incised with a cataract knife. A gush of straw-colored fluid was followed by the escape of a small amount of vitreous. Three sutures were used to hold the conjunctival flap in position.



Green ___ ___ Red..... Blue _ _ _

Fig. 3.—Visual Field. Seven Months After Operation.

Postoperative history: During the night the patient complained of some pain, and the conjunctiva became very much congested, swollen and edematous; the chemotic conjunctiva covering the limbus completely. The eye was iced for twenty-four hours. In five days the swelling and chemosis were greatly reduced except at the site of operation, which showed bulging for five days longer, at which time the stitches were removed.

Fundus examination made three weeks after operation:

There are many minute granular opacities of the vitreous; the whole fundus is slightly hyperemic; the retina is somewhat edematous. Arteriovenous compression present. The superior macular vessels have silver wire characteristics. Very slight if any foveal reflex; the macular region is practically normal except that it is slightly granular about the foveola. There is a glistening white spot and a bright annular whitish line nearly surrounding it about 3 or 4 disc diameters temporally and about 1 disc diameter down from the foveola. No area of detachment can be discovered, the retina being apparently completely reattached.

Three weeks after the operation the vision in the left eye was $\frac{6}{15}$, and the field for form and color was nearly normal in extent (Fig. 2). Refraction: Left eye +0.50 sphere. Tension, O. D., 20 mm.; O. S., 20 mm.

The last observation made eight months after the time of operation showed the vision $\frac{6}{12}$. Tension 20 mm., and visual field nearly normal (Fig. 3). There was no change in the fundus findings from those made three weeks after the operation. The vision had increased from $\frac{4}{60}$ to $\frac{6}{12}$.

Two other cases of detachment of the retina were treated by trephining the sclera alone, without improvement. As this is the first case of detachment of the retina from any cause which I have been able to relieve I am prompted to place it on record.

DISCUSSION

DR. WILLIAM ZENTMAYER, Philadelphia: Two years ago I had under treatment at the Wills Eye Hospital a lad with detachment of the retina. All other things having failed, I resorted to trephining, having just met with an abstract of Holth's paper, in which he had reported cases in which he had successfully performed trephining for this condition. The result in my case, however, was entirely nil. The case was unfavorable. He had had the same condition in the other eye, and it had gone on to complete detachment. I had trouble in trephining, because the eyeball was so soft. Dr. Holloway told me later that the patient had to go into School for the Blind, not having been in the least benefited by the operation.

REPORT OF A SERIES OF EXTRACTIONS OF CATARACT IN THE CAPSULE AFTER SUBLUXATION WITH THE CAPSULE FORCEPS.

ARNOLD KNAPP, M.D.,

New York City.

After my visit to Colonel Smith in India, where I had the privilege of extracting cataracts in the capsule under his guidance, I attempted this operation here in New York, but failed to dislocate the lens by external manipulation without subjecting the eye to greater pressure than seemed wise. I therefore abandoned this method and returned to the old capsulotomy operation with the capsule forceps.

Dr. C. B. Meding, of New York, drew my attention to the Kalt capsule forceps, the extremities of which are flattened, cup-shaped and without teeth. As these forceps are blunt, they have, according to Kalt,* the great advantage of not tearing the capsule at the place of application but at the circumference of the lens, so that most of the anterior capsule is removed. In using these forceps I found that in many cases the grip obtained on the capsule was so firm that after some manipulation the cataract became subluxated, whereupon it could be extracted in the capsule with very slight external manipulation and very little trauma to the eye. In the cases where the capsule tore after applying the forceps before subluxation had taken place, a large piece of the anterior capsule was always obtained, and the operation was then no different from the old one.

Since February 9, 1910, I have performed 94 extractions of cataract in the capsule, after preliminary subluxation ac-

* Soc. d'Ophthalmol., Paris, 1909.

cording to this method, and I now wish to report upon these successive cases in full.

DESCRIPTION OF OPERATION: After the usual preparation and the instillation of one drop of atropin, under holocain anesthesia, the Koster speculum is introduced and left in place until the operation is completed, unless there is danger of or actual prolapse of vitreous. An assistant is necessary only in the presence of complications. The section must be large and should be just short of half the corneal circumference with a conjunctival flap. After the iridectomy, the capsule forceps are introduced to a point below the center of the pupil, the branches are then allowed to broadly separate and a distinct knuckle of capsule is grasped. The grasp should not be too tight lest the capsule be torn, but sufficiently firm to exert traction on the periphery of the lens capsule. The closed branches of the forceps are gently moved from side to side, up and down or rotated, and the capsule can be seen to follow in the various directions. When the dislocation has succeeded, a part of the margin of the cataract in the capsule appears free in the pupillary space. The portion dislocated is usually below, generally slightly to one side or the other, with the upper attachment unruptured. The forceps are then released and withdrawn. Pressure is exerted straight back on the lower part of the cornea with Smith's hook, and the cataract can be seen to turn a somersault; it "tumbles," in other words, as Smith calls it, and is delivered feet first. When the entire lens has been delivered, it will be found adherent above, where it is finally separated by a lateral stroking motion. In some cases the head presents first; the delivery is then slower and counterpressure must be applied at the scleral margin. The iris columns are then carefully replaced. The coloboma should ultimately not appear any different from that after an ordinary extraction.

Owing to the size of the lens in its capsule, and the neces-

sary rupture of its suspensory attachment, the columns are apt to become wedged into the iris angle and are extricated with more trouble than usual. The conjunctival flap is replaced and the speculum removed. Atropin ointment is introduced into the conjunctival sac and a dry dressing is applied. Both eyes are bandaged and the dressing is not changed for four days, unless some complication is feared. The unoperated-on eye is then left open and the patient is allowed up.

The treatment of vitreous prolapse is the same as in the ordinary operation. If the capsule ruptures during the expression of the lens it can generally be easily grasped and drawn out with the blunt capsule forceps, after the contents have been expelled. There is practically no after-treatment. There may be some deep opacity of the cornea, especially if the lens is very large and the incision small, but this disappears after a few days.

The advantages of an extraction in the capsule are, I think, generally accepted. The beautiful black pupil, the usual freedom from ciliary congestion, from iritis and all the troubles which retained cortex and capsular thickenings may cause, not to speak of the secondary operation, often more difficult than the primary extraction, must be convincing arguments in favor of the extraction in the capsule operation if the dislocation of the lens could only be simplified and the eye not subjected to too great risk. This is partly accomplished by the method of subluxation with the capsule forceps. The dislocation with the capsule forceps, however, only succeeds in a certain percentage of cases, which, roughly speaking, is from 40 to 50 per cent. The procedure generally fails in cataracts where the capsule is very thin and the subcapsular opacity is an uneven bluish-white. The operation should not be undertaken in unreasonable patients. It succeeds proportionately with the age of the cataract; the dislocation takes place easily in the hyper-

mature and sclerosed lenses, many of the latter being quite immature, and considerable sight remaining. In the "disciform" variety extraction in the capsule with forceps dislocation is much easier than by the Smith method.

Nearly a year after I began with this operation, Stanculeanu reported at the meeting of the German Ophthalmological Society upon a method of extraction of cataract in the capsule which seems to be practically the same as the one described in this paper. In a later article* he says that in the Bucharest clinic, Manolescu had for sixteen years practised removal of the anterior capsule of the lens in the cataract operation by means of the convex curve of the ordinary iris forceps without teeth. Stanculeanu abandoned the Smith operation after a trial of twenty cases, and developed a method of extraction in the capsule after dislocation with this Manolescu forceps which he had modified by the addition of a narrow groove along each branch of the forceps. He succeeded in dislocating the lens in the capsule with this forceps in 50 to 70 per cent., and is very well satisfied with his results. I have not used the Manolescu forceps, so I cannot compare it with the Kalt. The late Dr. Greene, of Dayton, Ohio, had used both forceps and preferred the Manolescu model, which he had had changed slightly by making the ends bulbous.

It seems to me that this is a legitimate and conservative development of our operative treatment of cataract which insures for many of our cataract patients the advantages of removing the cataract in the capsule without subjecting them to greater risk than the ordinary operation. Improvement in technic and in instruments should increase the percentage of cataracts which are capable of dislocation by this method.

* Klin. Monatsbl. f. Augenheilk., p. 527, 1912.

SUCCESSIVE LIST OF CASES.

No.	Name	Age	Condition of Lens	Vitreous or Complication	Healing	Final Result
1	Gilligan	51	Mature.	..	..	$\frac{20}{15}$
2	Davenport	82	Hypermature.	..	..	$\frac{10}{200}$ Dystrophia corn. epith.
3	Fredericks	67	Hypermature.	..	Vomited; hemorrhage in vitreous and retina.	$\frac{20}{40}$ Opac. vitr.
4	Held	82	Hypermature.	..	..	$\frac{15}{200}$ Central choroidal changes.
5	Hagenman	68	Mature.	+ Before extraction; loop used.	..	$\frac{20}{30}$ Opac. vitr.
6	Scheffmeyer	76	Mature.	+ Before extraction; loop used.	Cyclitis.	$\frac{20}{40}$
7	Ruzeck	58	Mature.	..	Iris prolapse.	$\frac{20}{}$
8	Goldman	61	Mature.	..	..	$\frac{20}{}$ Old mac. corneæ.
9	Gibson	66	Mature.	..	Hyphema.	$\frac{20}{}$
10	Pia	69	Mature.	..	Cyclitis.	$\frac{20}{}$
11	Oltman	68	Mature.	Section down; old iridectomy.	..	$\frac{20}{70}$ Opac. vitr. (old).
12	Keever	52	Mature.	Diabetes with acetone.	Iridocyclitis.	Proj. faulty.
13	Goldberg	34	Hyper. (traum.)	+ After section.	..	$\frac{20}{}$
14	Donovan	60	Mature.	..	..	$\frac{20}{}$
15	Held	83	Hypermature	..	..	$\frac{10}{200}$ Central choroidal changes.
16	Angier	61	Mature.	..	..	$\frac{20}{70}$ Central choroiditis, opac. vitr.
17	Everstein	82	Hypermature.	..	Hemorrhage in vitreous.	$\frac{20}{70}$ Myopia, choroidal changes.
18	Mathews	61	Mature.	..	..	$\frac{20}{70}$ Opac. vitr.
19	Hamer	48	..	..	..	$\frac{20}{}$ Membr. opac. vitr. (old).
20	Walsh	58	Immature.	..	..	$\frac{20}{}$
21	Humphries	64	Mature.	..	..	$\frac{20}{}$
22	Sangmar	73	Hypermature.	..	..	$\frac{20}{}$
23	Edelstein	64	Hypermature.	..	..	$\frac{20}{}$ Opac. vitr.

24	Humphries....	64	Mature.	..	..	20/15−	
25	Steller.....	51	Mature.	..	..	20/15−	
26	Farian.....	70	Mature.	..	Cyclitis.	20/15−	Opac. vitr.
27	McGivney	65	Mature.	..	..	20/15−	
28	Wiener.....	67	Mature.	..	..	20/15	
29	Stableford	60	Mature.	+ Followed lens.	Cyclitis.	20/70	Updrawn pupil, hyaloid cloudy.
30	Himmelweit...	70	Mature.	Previous glaucoma.	..	20/50	Optic atrophy.
31	Schnurle.....	64	Mature.	..	..	20/15−	
32	Terreforte....	68	Mature.	..	..	20/50	
33	Walsh.....	69	Immature.	..	..	20/30	
34	Hipp.....	69	Mature.	..	..	20/25	
35	Goldberg	44	Hypermature.	..	..	20/20	
36	Shea.....	60	Mature.	+ Before extraction; spoon used.	Neuroretinitis.	20/50	Opac. vitr.
37	Buggie	75	Mature.	..	..	20/25	
38	Goldbaum	63	Mature.	..	..	20/20	
39	Himovitch	59	Mature.	+ On closing eye. Ruptured caps. extracted.	Neuroretinitis.	20/70	Opac. vitr. opac. corneæ.
40	Blumberg.....	55	Mature.	..	..	20/30	
41	Gundel.....	66	Mature.	..	..	20/20	
42	Randall.....	70	Mature.	..	Retrochoroid. hemorrhage.		Enucleation.
43	Harty.....	73	Mature.	+ Squeezed; after extraction.	..	20/30	
44	Hoag.....	80	Mature.	+ Squeezed; after extraction.	..	20/40	
45	Feltman.....	47	Mature.	..	Iris prolapse.	20/15	
46	Greeley.....	68	Hypermature.	+ At end.	Iritis.	20/15	
47	Ryan.....	48	Mature.	Projection faulty.	..		M. H. old detachment. Opac. vitr.
48	Panowitz	45	Immature.	..	..	20/20	Myopic choroidal changes.
49	Hauptman	70	Hypermature.	..	..	20/15	
50	Levi.....	50	Mature.	..	..	20/20	
51	Hinkovitz.....	65	Hypermature.	..	..	20/30	

SUCCESSIVE LIST OF CASES—(*Continued*).

No.	NAME	AGE	CONDITION OF LENS	VITREOUS OR COMPLICATION	HEALING	FINAL RESULT
52	Goldstein	58	Mature.	..	..	$\frac{20}{20}$–
53	Brown	74	Hypermature.	Corneal opacity.	..	$\frac{20}{50}$ Myopic choroidal changes. Opac. vitr.
54	McGivney	65	Mature.	Corneal opacity.	Iritis.	$\frac{20}{70}$ Opac. vitr.
55	Matrass	72	Hypermature.	+ Capsule ruptured and extracted.	..	$\frac{20}{70}$
56	Zodikow	49	Immature.	Capsule ruptured and extracted.	..	$\frac{20}{30}$
57	Wehle	60	Hypermature.	..	..	$\frac{20}{50}$ Opac. vitr. (old), optic atrophy.
58	Janowitz	58	Mature.	..	..	$\frac{20}{70}$ Opac. vitr. (old).
59	del Valle	62	Mature.	..	..	$\frac{20}{30}$
60	Ginsberg	65	Mature.	+ Spoon delivery.	Neuroretinitis.	$\frac{20}{70}$ Opac. vitr.
61	del Valle	62	Hypermature.	+ After extraction.	..	$\frac{20}{30}$
62	Shapiro	49	Hypermature.	..	..	$\frac{20}{30}$
63	McNeeley	71	Hypermature.	..	..	$\frac{20}{50}$ Myopia, opac. vitr.
64	Gnautch	60	Immature.	.. ..	Struck eye. Vitreous hemorrhage.	$\frac{20}{70}$
65	Jacobs	62	Mature.	..	..	$\frac{20}{30}$
66	Buchman	62	Hypermature.	..	..	$\frac{20}{30}$
67	Redinger	68	Mature.	..	Detached choroid; hemorrhage.	$\frac{20}{50}$
68	Fitzpatrick	74	Mature.	..	..	$\frac{20}{30}$
69	Cook	60	Immature.	..	Detached choroid.	$\frac{20}{30}$
70	Fulham	58	Mature.	..	..	$\frac{20}{20}$–
71	Sullivan	65	Mature.	Corneal opacities.	..	$\frac{20}{70}$ Maculæ corneæ.
72	Shapiro	49	Mature.	Capsule ruptured and extracted.	..	$\frac{20}{30}$
73	Barry	60	Mature.	..	..	$\frac{20}{30}$
74	Keeley	68	Hypermature.	..	Faint hyaloid opacity.	$\frac{20}{30}$ Choroidal changes.
75	Michelfelder	72	Immature.	..	..	$\frac{20}{30}$

76	Binger.....	70	Immature.	Old glaucoma. Cystoid scar.	..	$\frac{20}{200}$ Deep corn. opac.
77	Harrison.....	51	Immature.	..	..	$\frac{20}{70}$ Opac. vitr.
78	Hirschfeld	64	Mature.	..	Prolapse iris.	$\frac{20}{70}$
79	Mayer.....	60	Mature.	..	..	$\frac{20}{70}$
80	Rosenfeld.....	57	Mature.	..	..	$\frac{20}{70}$
81	Maggio.....	60	Immature.	+ Followed extrac.	..	$\frac{3}{200}$ Myopic choroiditis; maculæ corneæ.
82	Shannon.....	71	Immature.	Previous glaucoma.	Cyclitis.	$\frac{20}{70}$ Updrawn pupil.
83	Barron.....	71	Immature.	..	..	$\frac{20}{70}$
84	Crosby.....	62	Immature.	+ At end of operation.	..	$\frac{20}{70}$
85	Bergin.....	49	Hypermature.	..	Iris prolapse.	$\frac{20}{70}$
86	Kasnovitz.....	54	Mature.	+ With lens.	..	$\frac{20}{70}$ Opac. vitr.
87	Beyer.....	67	Hypermature.	Capsule ruptured and extracted.	..	$\frac{20}{200}$ Retinitis (diabetic).
88	Gleason.....	73	Hypermature.	..	..	$\frac{20}{70}$
89	Marshall.....	49	Immature.	..	..	$\frac{20}{70}$
90	Strohofer	78	Mature.	..	Partial iris prolapse.	$\frac{20}{70}$
91	Bause.....	74	Mature.	..	..	$\frac{20}{70}$ Central chorioretinitis (old).
92	Libenow.....	64	Mature.	..	..	$\frac{20}{70}$ Opac. vitr.
93	McKean.....	51	Mature.	..	..	$\frac{20}{70}$
94	Poppe.....	62	Mature.	..	Iris prolapse.	$\frac{20}{70}$

SUMMARY: Mature 57; hypermature 23; immature 14.
Visual results: 20/15, 5; 20/20, 17; 20/20–, 8; 20/30, 24; 20/40, 11; 20/50, 7; 20/70, 13; 20/200, 2; fingers, 4; projection faulty, 2; total loss, 1.
Prolapse of vitreous: 15. The slightest loss of vitreous is counted: usually very small in amount; decided loss in 1 only.
Visual results of this group: 20/20, 1; 20/30, 6; 20/40, 2; 20/50, 1 (traumatic cataract); 20/70, 4 (2 mac. corneæ); 5/200, 1 (myop. mac. corneæ).
Capsule ruptured during extraction, separately extracted, 5.
Iridocyclitis: 8; Iritis, 5; Cyclitis, 3.
Prolapse of iris: 6 (including incarceration).
Detachment choroid (transient), 2.
Hemorrhage in retina and vitreous: 3 (1 of these traumatic).
Retrochoroidal hemorrhage: 1.
Uncomplicated: 70.
Complicated: 24.

Dystrophia corn. epithel.	1
Mac. corneæ	3
Central chorioretinal changes	6
Optic atrophy	1
Glaucoma (previous)	3
Detachment retina	1
Hemorrhage	1
Myopia (choroidal changes)	4
Opac. vitr. (old)	4

Of the 70, 63 obtained vision 20/15 to 20/40, 90 per cent.
2 " " 20/50
4 " " 20/70

Projection faulty, 1 (iridocyclitis, in diabetic subject with 8 per cent. sugar, acetone and diacetic acid).

DISCUSSION.

DR. ANDREW TIMBERMAN, Columbus, Ohio: I was very much interested in the paper just read by Dr. Knapp. I have felt for some time that he had something new to give to us, because I thought that his visit to India would result in something or another. To those of us who have had some experience with the Smith operation, this is a decidedly interesting innovation. It appears to me, just on the surface of things, that it may have decided advantages. As a pupil and disciple of Lieutenant-Colonel Smith, I still think that there are a great many advantages in the operation as done by him. On the other hand, I am frank to say that I have also tried the suggestion of Homer Smith, and find that it works admirably in certain cases; and I hope that I am broad-minded enough to say that I think it ought to be used in some cases, rather than the capsular operation as done by Lieutenant-Colonel Smith. It appears to me, however, that

the operation of Dr. Knapp may be an improvement over both of these. The results of his operation, as tabulated here, are very gratifying. He has a high percentage of good results, probably quite as high as has been reported by any other man, and as low a percentage of bad results. Judging from my experience with what Colonel Smith calls the hypermature cataract—hypermature ab initio—I should think this might be a difficult operation. I do not know, and cannot say yet. Perhaps Dr. Knapp can give us some information in regard to just what he does when he has a rupture of the hyaloid membrane. I should think the threatened loss of vitreous would be difficult to prevent with the forceps inside the eyeball. I should like to know whether Dr. Knapp ever has cases of luxation of the lens into the vitreous humor on account of these manipulations; and if he has them, what he does for them. These are only a few questions, the answers to which would be quite interesting.

There are certain classes of eyeballs in which I always begin the operation with a good deal of trepidation, especially the class with widely opened palpebral fissures. The patients freely open their eyes and roll their eyeballs around, so that you would think that you would not need a speculum; I am always afraid of what may happen.

DR. J. E. WEEKS, New York: It may be interesting to compare the results of a series of cases similar to Dr. Knapp's, operated on by the old methods, as really the success of any operative procedure depends upon the degree of vision we ultimately obtained in cataract extraction. Some fifteen or sixteen years ago, I reported one hundred consecutive cases of cataract extraction, by the simple and by the combined methods. In these cases 65 per cent., if I remember correctly, had a vision of $\frac{20}{20}-$, or better. In this series, we find a little less than 50 per cent. with a vision of $\frac{20}{20}-$, or better. In that series there were 4 per cent. of $\frac{20}{200}$, or less; in this, there were 9 per cent. of $\frac{20}{200}$, or less. I grant you that many of my cases had to have a capsulotomy; but what I reported were the ultimate visual results.

DR. C. F. CLARK, Columbus, Ohio: I am a great admirer of Colonel Smith's, but I cannot class myself as a disciple of his. My experience with this operation while I

was in India was very delightful. The results obtained were good, and everything was satisfactory. When I came home, I tried it in some cases, but I soon arrived at the conclusion that in our country the operation was applicable in only a few instances. Though I would grant that to remove the lens in its capsule is the ideal operation, yet I do not think that it can be satisfactorily performed in a large proportion of cases. I do not think that Dr. Knapp made the distinction between mature and immature cataracts. I should like to learn from him the results in his fourteen cases of immature cataract. It is very interesting to think that we shall some day find a means of dislocating the lens easily and removing it in the capsule in cases of immature cataract. We must aim at that, and perhaps we shall finally attain it.

Soon after my return from India I saw an article by Dr. Hulen regarding a suction apparatus devised by him for dislocating and removing the lens. I wrote to him and he kindly offered to send the apparatus to me in order that I might give it a trial. Unfortunately, the cases to which this procedure is applicable come only in small numbers, so that I did not have an opportunity to give the apparatus a fair trial during the short time I had it in my possession. I am satisfied, however, that there is something in it. The instrument was rather crude. At the end of the spatula there was a suction apparatus, and, while the vacuum tank worked well, the instrument was heavy and it took quite a while to manipulate it. I do not think, however, that one should be discouraged by the first experience with this apparatus. It works admirably in respect to getting a hold on the lens by suction. The disc is worked laterally by moving the handle from side to side, twisting the lens and breaking the suspensory ligament. The difficulty is in getting contact readily and satisfactorily without entanglement of the iris. I am convinced that after doing a full iridectomy, if, instead of making a round disc, which in his cases is rather large, Dr. Hulen would use an instrument made more in the form of an elliptical spatula which would be inserted easily into the pupillary space, he could dislocate the lens without rupturing the capsule or dislocating it into the vitreous. He would also have the advantage of being able to draw it

out by suction. I should like to see this instrument perfected and tested out thoroughly by some one with a large enough series of cases to come to some definite conclusion.

DR. ARNOLD KNAPP, New York: In answer to Dr. Timberman, it is exactly in the hypermature cataracts that this procedure succeeds with greatest facility. It is the experience of every one that in grasping over-ripe cataracts with the toothed capsule forceps one often succeeds in pulling them out. I have not had any experience with lenses dislocated in the vitreous as a result of the operative technic. I think this accident can be avoided as the pressure is exerted always away from the vitreous. In other words, after the capsule is grasped by the forceps the forceps are directed forwards and laterally. No force is ever applied directly backward after the capsule is seized. Dr. Weeks' visual results are surely marvelous. It is, however, not fitting to compare that series with this group of cases, as this is not presented so much from the standpoint of the visual results as the desirability of a new method of operating. Furthermore, the cases which I have just reported represent probable attempts of extraction along these lines in between 200 and 250 cataracts. There can be no question but that if the operation succeeds the patient will get all the sight that the eye is capable of. The ophthalmoscopic condition reveals any reason why sight should not be perfectly normal. In all justice it must be stated that the visual results in this paper are underestimated. There are many cases which are put down $\frac{20}{80}$ to $\frac{20}{40}$ visual acuity where there is no reason why the patient should not have full vision.

In answer to Dr. Clark, the behavior of the immature cataracts was not different from any of the others, though most of the cases in which the procedure succeeded were sclerosed lenses or those in which the capsule was tough. As I stated before, when the capsule is thin and the subcapsular opacity is bluish-white, the capsule nearly always ruptures in the attempt to dislocate. Regarding Dr. Hulen's suction apparatus, this has never appealed to me, as it offers too great an impediment in case something goes wrong during the operation, or if the patient should be unduly restless. Dr. Hulen informs me that he has himself given up this method.

PRELIMINARY CAPSULOTOMY IN THE OPERATION FOR THE EXTRACTION OF IMMATURE CATARACT.

HOWARD F. HANSELL, M.D., and C. E. G. SHANNON, M.D.,
Philadelphia, Pa.

The removal of the *entire* lens when vision is declining or has been reduced to the perception of light because of lenticular opacity is desired by every operator. Even though vision of full acuity may be obtained after extraction by division of the capsule, and the risk of that operation in skilful hands is practically insignificant, the necessity for the second operation is to be deplored. When, as so often happens, cortical remnants are entangled with the capsule and form with it an after-capsulo-lenticular cataract, repeated discissions with much less favorable prognosis are the rule. Our method of dealing with these opacities during the past year has differed slightly from the usual procedures, and we are inclined to believe it has some points of superiority. When the cortical matter lies in front of the capsule it is stirred up by the point of the knife-needle in the hope that it may be absorbed. When contained in the capsule the anterior wall of the cyst only is divided. To divide both at the same sitting incurs the danger of delaying absorption or rendering the opacity permanent because of the admixture of vitreous.

Homer C. Smith, in 1909, advocated division of the capsule in immature cataract, to be followed in six hours by the usual combined extraction operation. He claimed that the aqueous entered the incisions of the capsule and found its way around the periphery of the lens, separating it from the

capsule, thus permitting of the complete removal of the lens at the second operation. He reported 30 successful extractions of complete and incomplete cataract, having extended the procedure to include the former. By means of a specially-devised knife he makes a cross-cut in the capsule and in the most anterior layers of the lens without the loss of aqueous, and in six hours shells out the entire lens, without having done a second capsulotomy. His method is not meant to increase the opacity of the lens or ripen the cataract. It does not change an immature into a mature cataract, as in the needling operation. His object is to separate the lens from the capsule and indirectly to unite in one solid body the nucleus and the cortex.

The annoyance, anxiety, discontent, pecuniary loss and apprehension attendant upon the trying months or years of waiting for a cataract to be ready for safe extraction are familiar.

It is the ambition of each of us to find or devise some method by which a cataract may be successfully removed as soon as vision has declined sufficiently to warrant the risks of operation. The Smith-Indian method of operation has not recommended itself to American surgeons. The Stanculeanu method seems to be practically unknown and untried, excepting by Simpson, of Memphis, who is its warm advocate.

Our treatment of immature cataract in individuals under sixty years of age is to perform preliminary iridectomy and wait, or try one of the ripening operations, which nobody does, or extract and take the chances.

Our experience with preliminary capsulotomy, embracing 15 or more cases, has not brought us to a definite opinion as to its value. We have not followed, in every particular, the Smith directions. For example, for the sake of convenience, the interval between the two operations has been extended from six to twenty-four hours. No harm has

resulted; or, in other words, the lens has not in any case swollen to a dangerous degree. No symptoms of glaucoma developed or was the extraction made more complicated. Also, the knife-needle of Knapp or modified Hays knife of Ziegler was used in all but three cases, when Smith's own knife was substituted. Again, the discission was V-shaped rather than a cross. It was found to be an extremely difficult matter to satisfactorily make a cross without the loss of aqueous or greater traumatism than seemed right. It appeared to us that the important factor was to sufficiently incise the capsule, and that it made no difference in which direction the incisions were made. In all the cases the eyes were quiet and free from congestion at the time of the extraction, and there was no contraindication from proceeding at once with the second operation. The corneal cut and the iridectomy, if the latter had not been previously performed, were made as usual. The use of capsule forceps or the cystotome, or the omission of both, was indicated by the state of the capsule. In one or two cases after iridectomy the lens started forward spontaneously and was delivered by moderate pressure upon the cornea. In some the preliminary incisions in the capsule were only the faintest lines or altogether invisible, and in these the attempt was made to remove the center of the capsule with the forceps, or failing, the capsule was divided by the cystotome and the lens extracted. There was no loss of vitreous in a single case. Whenever the behavior of the patient or the appearance of the eye warranted it, the anterior chamber was irrigated. In restless patients who had apparently reached the end of their endurance, or when loss of vitreous threatened, the irrigation was omitted.

Results.—The apparent freedom from cortical remnants immediately after the completion of the extraction is not a guaranty that the entire lens has been removed. Inspection of the extracted lens is also not a safe guide. Even

the smallest fragment if retained in the capsule in the pupillary area, as a rule, requires subsequent treatment. The final result, as determined by the acuity of vision secured only by one or more discissions, does not establish the position of the Smith method as compared with the operations in which preliminary capsulotomy has not been performed. The question to be decided is whether the cutting of the capsule, as recommended by Smith, insures the separation of lens and capsule and the delivery of the complete lens. The formation of after-cataract, or the purely membranous opacity so common after extraction of either the mature or immature lenticular cataract, is entirely beside the question. It is not claimed that this form of after-cataract is prevented, and in considering the merits of the operation this should not be lost sight of.

Of 5 cases mentioned by one of the authors in the discussion of Friedenburg's* paper, the lens left its capsule completely in 4, and at no time after was there any cortical lens in the pupil. In the fifth, although the technic was identical, cortical remnants were abundant. This patient had, also, simple non-inflammatory glaucoma. Of the second series of 5 cases†, 2 were under fifty and 3 were over sixty years of age. In all, the cataracts were immature and the little residue of lens was entirely absorbed. They were capital examples of the value of the Smith operation. Of the third series of 5 cases the immediate results were disappointing. In 1, a man of fifty-five years, Smith's directions were followed as closely as possible. His own capsulotome was used. Capsulotomy and extraction were satisfactory. Capsule and lens matter occluded the pupil and a low grade of iritis persisted for weeks. The lens remnants, entangled in the capsule, were stirred up twice and finally the capsule was divided (three operations subsequent to

**Trans. Am. Med. Asso.*, Section on Ophthal., 1912.
†*Trans. Penna. State Med. Soc.*, 1913.

extraction, six altogether). In a man of sixty-four, lens fragments were retained, iritis of months' duration was followed by a dense membranous pupillary opacity. In a woman of sixty, the lens remnants were completely absorbed by the use of dionin. In a man of forty-two, the lens came out nearly entire and final vision was $\frac{20}{70}$ without a secondary operation. In a man of sixty-five, the result was no better than that of the usual operation. In a woman of forty-two the extraction was performed according to the regular method as a sort of control case. No preliminary capsulotomy was made. No lens debris remained and the result was excellent. Had preliminary capsulotomy been done, the coming away of the complete lens would have been attributed to that operation.

Our last case was a woman of thirty-eight who had myopia of about 25 D. An attempt was made to follow Smith's method of crucial incision, but, because of the limited area in which to manipulate his knife, the knife was withdrawn after the vertical cut had been made and reintroduced to the temporal side of the limbus in order to make the horizontal cut. The lens came away satisfactorily in the extraction and the pupil *appeared* clear. No irrigation was performed as the patient was extremely nervous and further manipulation seemed hazardous. The wound healed within twenty-four hours and the eye showed very little congestion. Considerable cortex, however, remained in the pupillary area.

Since writing this paper 2 additional cases have been operated upon, one a man, aged fifty-eight, had immature nuclear cataract. Some difficulty was experienced in attempting the cross-section of the capsule because of the escape of the aqueous during and after the vertical cut, and only a nick was made. The line of the vertical incision was clearly seen after operation and at the time of the extraction. Twenty-four hours later there was only slight

congestion of the eyeball; the lens was moderately swollen and presented through the gaping of the incised capsule.

Immediately following the corneal section, the lens was spontaneously expressed in its entirety, and the pupil was apparently perfectly clear. Three days after operation the wound was united, the anterior chamber refilled and the pupil free of lens cortex. The slight opacity in the pupil consisted of a few fine threads of capsule. In view of the fact that the capsule was incised in one meridian only, it may be that a single incision is sufficient in securing a satisfactory result.

In the second case a vertical incision only in the capsule was made. The lens presented and was easily expelled by gentle pressure on the cornea. Unlike the above case, the anterior chamber on the second day presented the diffused *opacity* of cortex that had been retained. The preliminary capsulotomy was in this patient a failure.

DISCUSSION

DR. WALTER L. PYLE, Philadelphia: I want to add my tribute to the very real value of dionin in aiding the absorption of retained capsular fragments. It is generally very difficult to remove all the cortical remnants, and I am very glad to hear Dr. Shannon report the good results with dionin in one of his cases. There is no doubt of the value of this remedy in such cases. It has never failed me in over ten years' experience.

DR. HIRAM WOODS, Baltimore, Md.: I want to relate my experience with three cases of the Homer Smith operation. The first patient was a man with double cataract. He was a railroad man, forty-three years of age, whose central vision was reduced to about $\frac{3}{200}$ from nuclear cataracts. He was unable to work. I had read Smith's communication. I obtained his knife, and in my first case did a preliminary capsulotomy on one eye, in the afternoon of January 7, 1913. The capsulotomy was done with the incisions described by Smith. I did not see the patient again until the

next afternoon; but at about ten o'clock that morning I got a message from the nurse at the hospital that the man had a great deal of pain and nausea. In the afternoon I found, with the fingers, what I should take to be a tension of +1, or higher. It was not measured with the tonometer. I made an immediate extraction of the lens. The appearance of the lens had not been changed, but the iris was distinctly bulging forward. The only complication was a rather profuse hemorrhage at the time of the iridectomy. The patient recovered without further incident. The pupil was entirely clear of any remnants of soft substance, and he obtained $\frac{20}{20}$ vision in that eye.

Two weeks later, the second preliminary capsulotomy was done at eight o'clock in the morning. Early in the afternoon, the cataract was removed with an iridectomy. I followed Smith's directions accurately, allowing between six and seven hours between the two operations. There was no reaction, and no soft substance. When I last saw the patient, he had normal vision in both eyes.

The third case was that of a man, forty years old, who had lost one eye from a cataract operation in another city, and I wanted to give him every possible chance. He had an opalescent cataract; $V = \frac{6}{200}$. I did a preliminary iridectomy January 16, 1913, waited till 13th of February, and then did a preliminary capsulotomy in the morning, intending to extract the lens in the afternoon. He felt unwell in the afternoon, but the eye was quiet. He grew worse and apparently had an attack of grippe. I had to wait nine days, to February 22nd, before I could remove the cataract. The eye showed no irritation during this time, and when the extraction was done, the lens came away readily, leaving a clear pupil. He obtained almost $\frac{20}{20}$ vision. There was no hemorrhage in this case; but in both the other cases, there was a profuse iridectomy hemorrhage. These cases bore out Smith's contention that this operation brings away the entire lens.

I want to compare these cases with another operated on recently. A woman, with an old central choroiditis, wanted an immature, nuclear, and probably secondary cataract removed. Owing to circumstances that I could not control, she did not come in time for a preliminary capsulotomy; and

I extracted the partially clear lens without the preliminary capsulotomy. I had done a preliminary iridectomy two months before. In this case, there was a lot of soft lens substance which had to be removed by irrigation. The patient did well, but has only $\frac{20}{80}$ vision from $\frac{20}{200}$.

These cases seem to bear out Smith's statement that preliminary capsulotomy is efficacious in separating soft cortical substance from the capsule, and making it adhere to the lens. In the first three cases, I had no cortical matter to deal with. In the case in which the preliminary capsulotomy was not done, there was considerable soft lens substance.

DR. ALLEN GREENWOOD, Boston, Mass.: I think that we ought to tell our experiences in these things to help in deciding whether these operations are an advantage. I have tried this method in only two cases. The first was one of high myopia, with a nuclear cataract. It seemed to me that in this case, with a vision reduced to $\frac{20}{400}$, and the patient not able to do much, removal of the lens was really necessary. I performed the Homer Smith operation, just as Dr. Hansell described, making a V-shaped incision, with the point of the V upward. The thing that struck me was the ease with which the lens was expressed on the following day. It came out looking as if it were in the capsule, it being so smooth and in such good condition.

In the second case, there was a small amount of cortical remnant. The first patient obtained $\frac{20}{20}$ vision, without subsequent trouble, and the second $\frac{20}{30}$. These two cases, of course, amount to very little from which to draw a conclusion, but the easy way in which the lens came out of the eye, with but little pressure, excelled that observed in ordinary cataract extraction.

DR. ZIEGLER: I again wish to emphasize the fact that it is better to call this operation a *preliminary cystotomy*, rather than a preliminary capsulotomy. I also want to add a word to what I have said before when discussing this question, that is, that if we wait beyond the period of six or seven hours, we have the question of a swollen lens and a shallow anterior chamber to contend with, which makes it a more difficult situation to handle. In the Wills Eye Hospital,

we must wait twenty-four to forty-eight hours before extracting the lens. We have no opportunity to operate within six or seven hours after the preliminary operation. In other words, we usually operate on alternate days and the interval between these is probably too long to wait.

The last case that I operated on developed an additional complication, that of a tender eyeball (ciliary pain) which made the patient very nervous, and resulted in the unavoidable accident of an automatic Smith-Indian operation. I had some of the same post-operative complications that I have seen occur in those cases. There was marked redness of the eye, considerable distortion of the cornea, and this curious after-effect, that notwithstanding the fact that the vision was $\frac{2}{40}$, the eye at times took on a strange spasmodic action that made it almost blind. The patient could hardly see to find her way around. I had seen this occur in one other case of intra-capsular extraction.

I desire to repeat what I have previously stated, that this appears to be a valuable procedure with which we may be able to help out a number of our patients who require relief from the delay of immature cataract.

DR. C. E. G. SHANNON, Philadelphia: I might say, regarding the experience of Dr. Woods, that in none of our cases was there any untoward effect, either immediately or within twenty-four hours. The eye was uniformly quiet, with no congestion, and the patients suffered no pain whatever. We do not feel convinced entirely in regard to the value of the operation, but, in view of the fact that Dr. Homer Smith, in his 30 operations, had such uniformly good results, we think that the procedure should be further tried, and its value definitely proved, if possible. In 30 per cent. of the cases, it was not found necessary to incise the anterior lens capsule. In approximately 50 per cent. no secondary operation was necessary; and I might add that the ultimate visual results were good in all cases except one, in which a chronic iridocyclitis developed, necessitating eventual enucleation of the eyeball. Dionin was used in practically all cases, and found to be exceedingly advantageous. In 30 per cent. of the cases, I should say, we did a preliminary iridectomy—that is, a preliminary iridectomy had

either been done previously or was done during the extraction operation.

With regard to Dr. Ziegler's reference to shallowness of the anterior chamber, I would say that in our experience I do not recall any case in which such a difficulty was encountered.

A NEW DOUBLE-DISC OPHTHALMOSCOPE, WITH INDEPENDENT DRIVING GEARS, AND IMPROVED ELECTRIC LIGHT ATTACHMENT.

S. LEWIS ZIEGLER, M.D.,
Philadelphia.

1. This ophthalmoscope consists of two discs, one containing a series of plus lenses and the other of minus lenses, which are symmetrically superimposed, assembled as a unit, and mounted in a dust-proof case.

2. Both discs have individual gears and are interlocked with a central bevel, thus permitting the plus and minus numbers to appear on the same plane and to be read through the same opening, which includes the peep aperture.

3. Three types of driving gears have been proposed:

   a. Two eccentrically superimposed driving wheels, the right lower one driving the plus disc and the upper left one meshing with the minus disc. This type requires manipulation by both thumb and forefinger which is awkward to manage when joined to a heavy battery handle.

   b. Two driving wheels set in a vertical tandem, one driving the plus disc and the other driving the minus disc through an interposed geared wheel. This type is longer and more cumbersome to handle, but can easily be moved by the forefinger.

c. One small meshed wheel driving the plus disc while the minus disc is milled and exposed through an opening in each lower quadrant of the case thus permitting direct manipulation. This type is shorter and more easily manipulated when joined to the battery handle as the wheel and disc can both be moved by the forefinger alone. This gear has, therefore, been adopted as most satisfactory for general use, either with the plain ophthalmoscope or with the electric light attachment.

All these types permit the same freedom from manipulative interference that is found in Morton's ophthalmoscope.

Fig. 1.—Front view of Ophthalmoscope, showing battery handle and rheostat.

Fig. 2.—Back view of Ophthalmoscope.

4. The lenses are held by metallic fastenings and mounted with a −16 D. lens on the plus disc and a

+16 D. lens on the minus disc, which arrangement trebles the series of lenses from thirteen to thirty-nine, when the proper numbers are superimposed. In this way a total of seventy-eight distinct combinations can be made, which is fourteen more than the ophthalmoscope of Loring will yield. The correct reading is obtained by adding or subtracting the two sets of numbers exposed. The lower or plus disc contains 0, +.50, +1, +2, +3, +4, +5, +6, +7, +8, +10, +12, +14 and −16 D. The upper or minus disc contains 0, −.50, −1, −2, −3, −4, −5, −6, −7, −8, −10, −12, −14 and +16 D. This brings 16 D. and 0 next to each other and by crossing gives a range of from 0 to 30 D., with half diopter intervals up to 8 D., with 1 D. intervals up to 24 D., and with 2 D. intervals up to 30 D. The following serial numbers can be obtained in both plus and minus lenses: 0, .50, 1, 1.50, 2, 2.50, 3, 3.50, 4, 4.50, 5, 5.50, 6, 6,50, 7, 7.50, 8, 9, 9.50, 10, 11, 11.50, 12, 13, 13.50, 14, 15, 16, 16.50, 17, 18, 19, 20, 21, 22, 23, 24, 26, 28, 30.

5. Instead of the usual quadrilateral mirror, 20x30 mm., a round tilting mirror has been attached, having a diameter of 22 mm., an aperture of 2 mm., and a curvature of −1.50 D. A small friction pivot is also provided to prevent undue tilting of the mirror. This mirror is omitted when the electric light attachment is used.

6. The chief advantages of this model are these:

b. Separate discs for plus and minus lenses.

a. The numbers of both discs showing on the same plane.

c. The large series of lenses, 78 in all, ranging from 0 to 30 D.

d. The ability to turn at once from 0 to +16 D.

e. The ease of manipulation, because the driving wheels are set low enough to avoid the eyebrow.

IMPROVED ELECTRIC LIGHT ATTACHMENT FOR ZIEGLER OPHTHALMOSCOPE.

1. The electric light attachment is joined to the ophthalmoscope as a *unit*, and is made interchangeable for (*a*) magazine battery, (*b*) accessory handle, cords and pocket battery, or (*c*) street current properly controlled.

2. The magazine battery handle is made compact to avoid bulk, and marketed in two sizes, the smaller type of Crampton handle being more handy but less efficient and the larger type being more awkward to manipulate but having about four times longer life. The writer prefers the smaller type solely for its greater convenience. The handle, cords and pocket battery are sometimes better adapted for bedside use. The battery case is made of metal, knurled and finished in a permanent black.

3. The special rheostat is located on the top of the magazine, and connected to the positive pole, in order to avoid accidental lighting of the lamp and rapid exhaustion of the battery whenever the battery handle is inadvertently laid on a metal surface. This fault is present in the majority of ophthalmoscopes that are joined to magazine batteries.

4. To avoid annoying reflexes the tube which carries the condensing lens, the U-shaped mirror of Marple, and the tungsten lamp, is specially treated and blackened inside. The sliding friction joint permits proper adjustment of the lamp filament vertical to the slot in the mirror. A similar adjustment can be made by rotating the lamp alone. If the lamp gives a reflex this may be reduced by frosting the tip, but the illumination will also be reduced.

5. A small spring contact socket is located in the tip of the adjustable or focusing slide, which maintains the connection even if the lamp should become unscrewed a few turns, and thus prevents flickering of the lamp while the instrument is in use. A second spring contact is located in

the peripheral end of the focusing slide, and a third spring contact is placed in the accessory handle to preserve uniform contact between the ophthalmoscope and the handle. The corrugated outer collar of the focusing slide is made much smaller than in most instruments and can easily be manipulated with one finger.

6. The U-shaped mirror of Marple has been made of polished metal and beveled to a very thin edge. It is, therefore, both non-breakable and interchangeable. It has a focal strength of −1 D. and yields a clear image free from penumbra.

7. Two small metal caps or tubes are provided to slip over the naked lamp after removing the ophthalmoscopic head, the larger one (a) for transillumination of the globe or sinuses, and the smaller one (b) for the Wernicke pupillary inaction test.

8. A separate retinoscopic head, containing a plane mirror and an extra lamp, can be adjusted to either form of electrical attachment.

My personal thanks are due to Mr. Henry L. DeZeng for the skill he has displayed in working out many complicated mechanical problems and for the close attention he has given to the construction of these instruments in a very limited space of time.

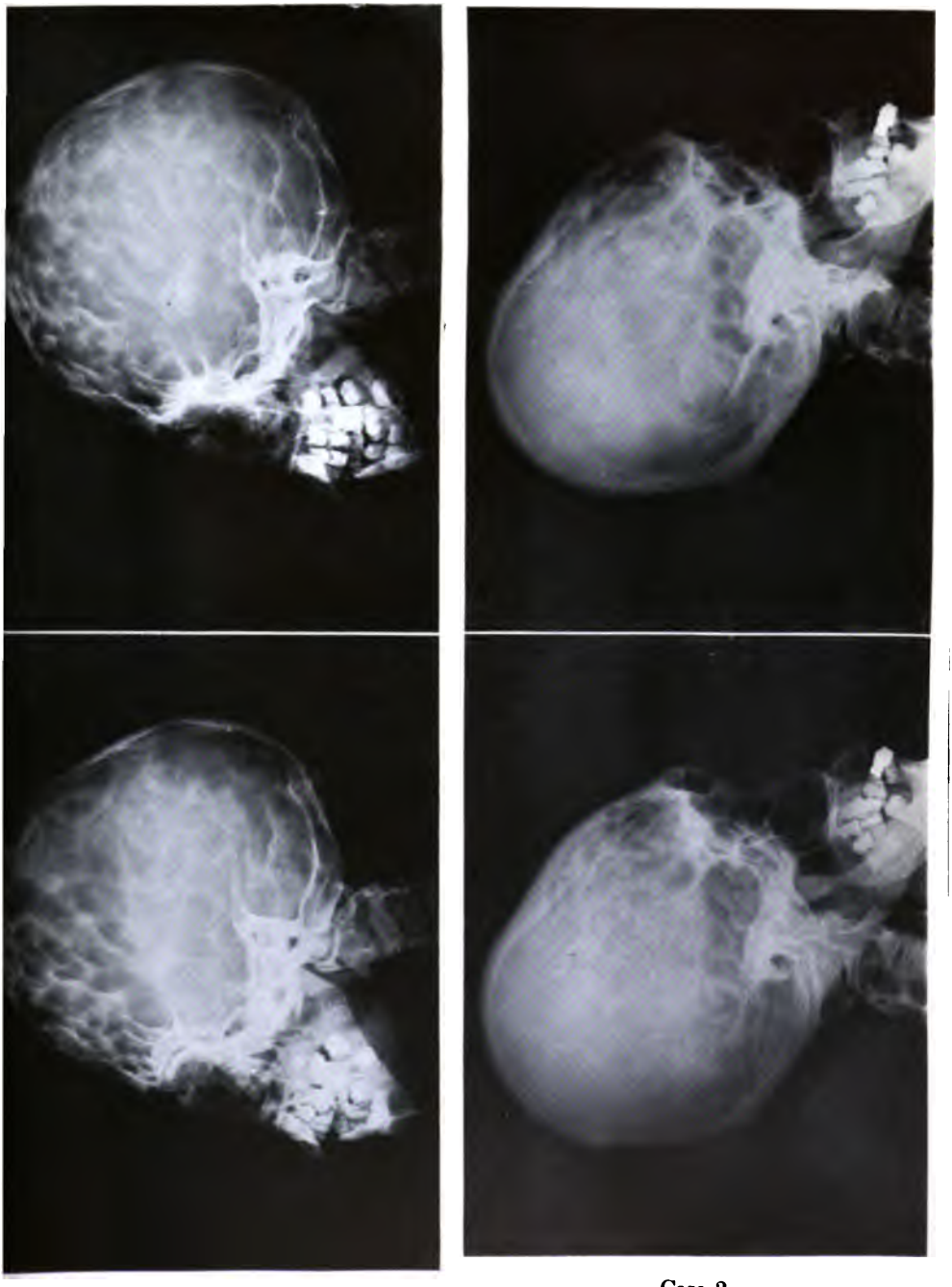
CRANIAL DEFORMITY ASSOCIATED WITH OCULAR CHANGES.

T. B. HOLLOWAY, M.D.,

Philadelphia.

In presenting this subject to the Society I do so mainly to exhibit the stereoscopic views of the very interesting *x*-ray findings that characterize these cases. While some reference will be made to the pathology and the operative treatment, no attempt will be made to discuss in detail the various phases of this subject, which have been so admirably treated in the contributions by Enslin,[1] Krauss, Friedenwald, Oliver, Patry, Meltzer, Fletcher,[2] Larsen,[3] and others. It may be briefly stated that the classic signs presented by these cases are the cranial deformity; exophthalmos; strabismus, usually divergent; and consecutive optic atrophy; and with these nystagmus is usually associated. Some of these may, of course, be absent and doubtless many cases of tower skull or turmschädel are encountered where the discs are healthy. On the other hand, most of the cases on record first sought relief for defective vision dependent upon a postneuritic or postpapillitic atrophy, although in a few cases the atrophy was not regarded as of the consecutive type.

Case I. G. B., aged eight. First came under observation at the Pennsylvania Institution for the Instruction of the Blind, where he was admitted in November, 1913. His application blank showed that it was noticed that his eyes were not normal "very soon" after birth, and at six months his vision was noted to be much impaired. He walked at the age of one and a half years. He has had chicken-pox



Case 1

Case 2

These pictures are properly mounted for use in the hand stereoscope.

and measles, but never any kind of convulsions. He is bright and intelligent, and succeeds quite well in his school work. He has one healthy brother. The father of the patient has had "specific disease." The mother is strong and healthy.

Upon examination of the patient, one is immediately impressed by the exaggerated type of adenoid facies and the peculiar conformation of the skull, which was of the tower or turmschädel type. There was distinct facial asymmetry with deflection of the nose toward the left side. There was a distinct bilateral exophthalmos; with Hertel's exophthalmometer the proptosis of the right eye was 21, and of the left 19 mm. There was a divergent squint, the patient preferring the right eye for fixation. Nystagmus of the mixed type was also present. The corneæ were clear, the pupils were equal, and reacted moderately to direct light. There was a consecutive atrophy of each optic disc. The vision of the right eye was reduced to counting fingers at fifteen inches, while with the left eye he could only perceive shadows.

Dr. Francis Sinkler reported that the station, gait, and reflexes were normal, and that there was no motor or sensory disturbance. There were slight evidences of rickets. The teeth were irregular but not of the Hutchinson type. The palate was highly arched. There was also present a well-compensated mitral stenosis. There were no other deformities.

Dr. Wm. Penn Vail, who examined his nose, throat, and ears, reported that the nasal septum deviated slightly to the left, and that the turbinates were slightly enlarged. Each drumhead was retracted and anemic, and apparently adherent to the posterior (internal) wall of the tympanum, and on each membrane there was an area suggesting a calcareous placque. The hearing of the right ear was somewhat better than the left. Recently the tonsils had been successfully removed. The sense of smell was impaired. A Wassermann test, made by Dr. Richardson, of the Ayer Clinical Laboratory of the Pennsylvania Hospital, was negative.

Dr. H. K. Pancoast, who made the *x*-ray examination, reported that the deformities seemed limited to the anterior

half of the skull. The digital impressions were very decided, and involved the entire inner table. The skull was not too thick for the age of the patient. The frontal sinuses appeared to be about the proper stage of development; the posterior ethmoidal cells were not encroached upon, while the sphenoidal sinuses had not developed. The pituitary fossa was enclosed to a certain extent, and the walls were thick, but there was no deformity of the fossa itself. The anterior fossa was narrow and shallow. The posterior fossa was about normal in appearance. The middle fossa of the skull was relatively wide in the anteroposterior diameter. While possibly not actually too wide, it seemed to be unusually deep.

Case II. N. H., female, aged 35, was referred to me by Dr. H. McV. Brown, owing to defective vision. A deformity of the head and peculiarity of the eyes were noted at birth. As an infant she was delicate and in poor health, said by the father to be due to marasmus, but the patient stated she had "water on the brain." Menstruation began at the age of fourteen and was always accompanied by severe pain. In 1904 a dilatation and curettement was performed. For years she had suffered from obstinate constipation, severe headaches and dizziness. During the past seven or eight years she has had short periods of misty vision, and attacks of hematuria and hematemesis. She has always had defective vision. Her mother died after an operation performed for some complication following pregnancy. One sister died of consumption and one of heart and kidney disease.

The face was asymmetric; the nose deviated to the left. The eyes were slightly proptosed, the left the more so. When the patient was first seen, seven years ago, the corrected vision of the right eye was $\frac{5}{15}$, of the left $\frac{5}{5}-$. There was a divergent squint of the right eye but no ocular palsies. Upon lateral rotation of the eyes, rotary nystagmoid movements developed near the outer limits of rotation. The pupils were equal and reacted to light. Each disc showed a well-marked postpapillitic atrophy with perivascular lines along some of the retinal vessels.

While seen at odd intervals, no opportunities were

afforded for thorough study until recently, when she consented to enter the University Hospital in the service of Doctors Stengel and Austin. The eyes presented much the same appearance as above described, although the vision, as previously noted, was not so good as when first seen. V O. D., $\frac{6}{45}$; O. S., $\frac{6}{24}$. The proptosis as measured with Hertel's exophthalmometer gave 16 mm. for the right eye and 17 mm. for the left. The fields are shown on the accompanying charts (Figs. 1, 2 and 3). Examination of the mouth and throat showed a moderate gingivitis and pyorrhea with slight enlargement of the tonsils. The thyroid was not

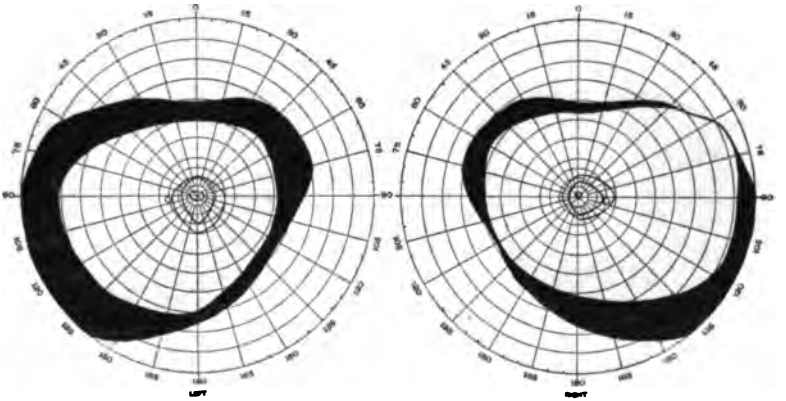


Fig. 1.—Case II. Visual Fields, July 2, 1907.

enlarged. The patient was chicken-breasted, and there existed a slight lateral curvature of the spine in the upper thoracic region. There were no pulmonary lesions. Examination of the heart revealed a soft systolic murmur over the mitral and aortic areas, with accentuation of the second sound of the pulmonic area. The systolic blood-pressure was 123, the diastolic 85. The knee-jerks were slightly diminished, no ankle clonus or Babinski sign; but with the eyes closed there was a marked sway and tendency to fall. Several examinations of the urine have shown a trace of albumin but no sugar; on one occasion hyaline casts; considerable mucus and a few blood-cells. A blood examination gave 68 per cent. hemoglobin; 4,310,000 red cells and 6700

white cells. Examination of the feces was negative for blood; gave faint bile reaction; no ova or parasites; many meat and vegetable fibers. Fluorescopic examination of the abdomen showed a marked ptosis of the colon, the transverse colon being at the level of the symphysis. A Wassermann test of the blood and cerebrospinal fluid was negative. Examination of the nose revealed a large spur on the right side with the septum deviated to the left. Slight postnasal catarrh; no sinusitis; sense of smell impaired.

The *x*-ray examination, as reported by Dr. H. K. Pan-

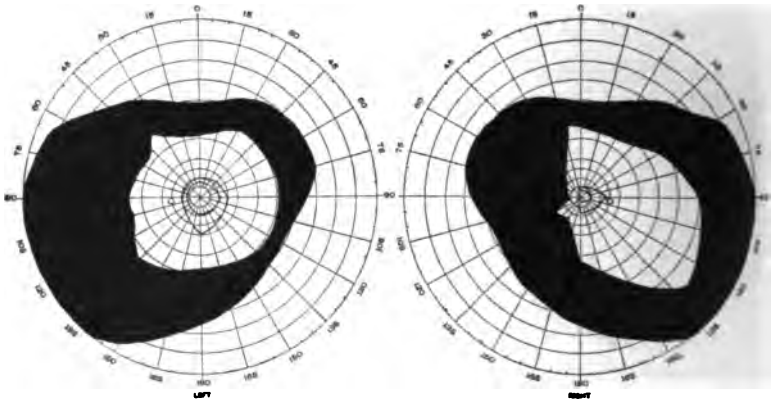


Fig. 2.—Case II. Visual Fields, March 11, 1912. Not examined for green.

coast, showed that the deformity seemed limited to the anterior half of the skull, and suggested a premature ossification of the coronal suture, mainly. Digital impressions seemed limited to the anterior portion. The tables were unusually dense and thick. The frontal sinuses, while not overlarge, did not appear to be abnormally small. The posterior ethmoidal sinuses were not affected. The sphenoidal sinuses were encroached upon from above and behind. The pituitary fossa seemed depressed forward and downward, and to a certain extent was enclosed; the walls were thick. The middle fossa of the skull was wide in the anteroposterior diameter and deepened. The anterior fossa was shallow and narrow in the anteroposterior diameter, but

not so narrow as in Case I. The character of the skull deformity is well shown in the accompanying *x*-ray plates. The measurements were as follows:

Anteroposterior diameter,	163 mm.
Staphanion diameter,	123 mm.
Maximum transverse diameter,	135 mm.
Maximum circumference,	490 mm. (no deduction for hair)
Binauricular curvature,	350 mm. " " " "
Binauricular diameter,	127 mm.

The skull was brachycephalic, the cephalic index being 82.8.

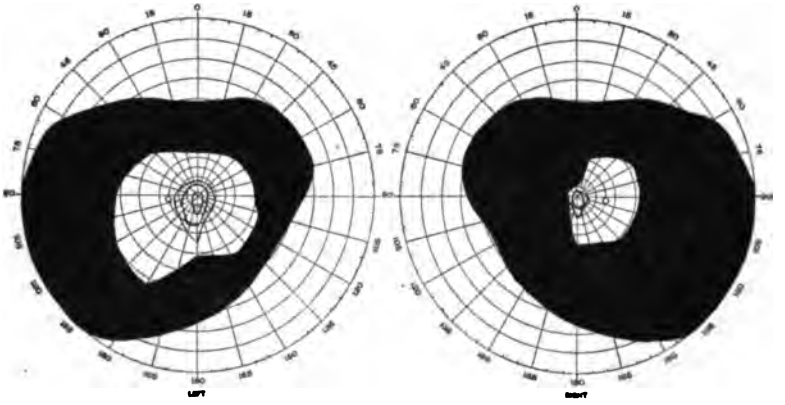


Fig. 3.—Case II. Visual Fields, April 3, 1913. Green not recognized with right eye.

Owing to the complexity of the symptoms and clinical findings in Case II, it is impossible to say whether the slow but progressive loss of vision has been dependent upon the primary injury to the nerves or whether other factors—for example, the several copious hemorrhages for which no cause has been found—have produced further deleterious effects. Neurological opinions expressed prior to the recent negative Wassermann tests, make it uncertain as to whether certain nervous manifestations were functional or organic.

In the majority of these cases the fields are found to be concentrically contracted, but it will be noted that Case II ultimately developed a nasal hemianopsia on the right side

(Fig. 3) analogous to changes, partial or complete, that were shown in the cases of Friedenwald, Anton and Patry. In neither case were there any associated congenital deformities and no history of heredity, although the latter has been noted by some observers (Hirschberg, Oeller, Hamy, Fletcher, Carpenter, Harmon[4] and Stephenson[5]). While statistics show a decided preponderance of cases of tower skull among the male sex, the fact that women have greater opportunities for concealing cranial deformities may accentuate these figures. The principal changes shown by *x*-ray studies in cases of this character are (1) the flattening of the orbits due to pressure of the brain against the great wing of the sphenoid, so that instead of forming the outer wall of the orbit it tends to form the posterior wall. (2) The middle fossæ is usually deepened, and in certain cases distinct alterations have been found in the pituitary fossa. (3) The inner table in part, or throughout its extent, shows characteristic markings referred to as digital impressions, attributed to impressions from the brain convolutions by the majority of observers, although Fletcher regards them "as an indication of some change in the actual structure of the bone due to abnormal growth the nature of which is obscure."

In tower skull (oxycephaly) the synostosis has been attributed to various sutures, frequently the parietal with the occipital and temporal and the coronal suture; the increased height being regarded as compensatory. But not only has there been a difference of opinion as to the sutures affected, but a still greater diversity of opinion has been expressed as to the cause of the premature synostosis. Virchow, Hirschberg, and most of the early writers attributed this to a meningitis. Meltzer believed it due to the reaction of a rachitic skull to a moderate hydrocephalus associated with a serous meningitis. Krauss thought the bones of the skull to be affected by a chronic inflammatory condition,

perhaps a true rachitic process. Carpenter expressed the opinion that the theory of premature ossification would not "hold water," and for want of a better term attributed it to a vice of development. Anton, while not attributing his case to such causes, has referred to the rôle of certain endogenous and exogenous poisons in relation to bony development, and with others, in this connection, has referred to cretinism. Fletcher, writing in 1911, excluded meningitis, rickets, and hydrocephalus, and believed that the skull deformity was but a local manifestation of a much more general condition of obscure origin. In this he coincided with Bertolotti, although he excluded his view that it was a dystrophy of rachitic origin. He offered the suggestion that some alteration in the pituitary body might be responsible for these changes. Three of Fletcher's seven cases had other associated deformities, and such anomalies have been found by other observers (Carpenter, Taylor, Donaldson, Ford, Dodd and McMullen, and probably others).

The opinions expressed as to the origin of the optic nerve changes have likewise been variable, but the theories can be grouped as either inflammatory or mechanical.

In the cases of Michel, Ponfick and Manz, bony constriction of the optic foramen was found at the autopsy and was assigned as the cause of the nerve changes, but Manz also referred to a possible meningeal origin to which Virchow and Hirschberg have attributed the alterations in the optic nerves. Since then this theory, in certain instances with some modifications, has had many supporters. Ambialet, in the report of his case history with autopsy notes, attributed the lack of optic nerve changes to the absence of a basal meningitis. Friedenwald, who contributed the first American paper on this subject, was the first to suggest the possibility of the nerve changes being secondary to increased intracranial tension, the result of greater resistance to the growth of the brain. In Larsen's case the blindness and

the hydrops of the vaginal sheath found at autopsy were regarded as due to increased pressure. In this patient, as well as in Ponfick's, death was due to a purulent meningitis evidently originating from the nasal cavities through a well-marked defect in the floor of the anterior cerebral fossa. Behr found at the autopsy on his patient that the internal carotid artery, by encroaching upon the lower part of the optic foramen, produced a stenosis of the foramen with consequent lymph stasis. He believed that intracranial pressure might play a secondary rôle and tend to increase the constriction. A similar vascular stenosis was found at the autopsy on the patient studied by Vorschütz and Jores.

These various opinions and autopsy reports* warrant the opinion expressed by Brav that in the light of our present knowledge no single causal factor can be adduced to answer all cases; but the writer cannot agree with him that either these opinions and findings or certain clinical features would permit the exclusion of increased intracranial tension as a possible causal factor. The changes described by Behr are of interest to the writer because it further emphasizes the importance of the basal vessels in relation to the exposed intracranial portion of the optic pathway, a subject previously discussed by de Schweinitz and the writer[6] in reference to growths in and about the pituitary gland and in the frontal lobes. While this vascular stenosis has been found at autopsy in two instances, and may be a contributing factor in certain cases, it does not necessarily follow that the distortion of the wing of the sphenoid, brought about by the brain pressure, would in all instances be sufficient to produce this anomaly.

As is well known, many of the recorded cases of this character have been studied in institutions for the blind, but Larsen's figures of 13 cases among 95 pupils in the Copen-

* Reports of autopsies are also given by Carpenter and Bourneville.

hagen Institution for the Blind stands out in marked contrast to my own experience at the Pennsylvania Institution for the Blind at Overbrook, where the patient whose history is above recorded is the only one I know of among 205 pupils. However, the fact that many of these patients ultimately do come within the scope of such institutions makes the question of operative interference one for serious consideration. Since Friedenwald in 1893 suggested increased intracranial tension as a possible cause of the optic nerve changes several cases of this character have been subjected to operative procedures. Dorfman's patient, a child of four years with bilateral choked discs, was trephined by von Eiselsbergs. Three weeks after the operation the discs had subsided 1 D., and the vision of the right eye had increased from $\frac{6}{30}$ to $\frac{6}{20}$, and in the left from $\frac{6}{60}$ to $\frac{6}{24}$. On Anton's patient, a male, aged thirty, with postneuritic atrophy, Bramann performed a ventricular puncture. The headache and dizziness disappeared and the vision improved in the right eye from $\frac{5}{15}$ to $\frac{2}{3}$. Recently Schloffer,[7] acting in accordance with the autopsy findings in Behr's case, performed what he terms his "canal operation." Briefly stated, this operation consists in removing the roof of the optic canal, the approach being through the lateral frontal region. The first patient was eight and a half years old, and had bilateral optic atrophy; the vision of the right eye was reduced to counting fingers; the left eye was amaurotic. Following ventricular puncture and a cerebral decompression, the canal operation was performed in two stages. Five weeks later the patient had a light perception in the left eye, while the field of the right eye had enlarged. In the second patient, aged twelve years, the discs presented the appearance of a chronic neuritis without vascular changes (Elschnig). The vision of the right eye was 1.00; of the left .3. Some four months after the operation the vision of the left eye, the side of operation, remained about

the same; while the vision of the right eye had depreciated to $\frac{6}{18}$. While some slight improvement has been noted in these cases, the character and number of cases certainly do not afford the material from which we can draw any definite conclusions. In dealing with these cases we are confronted on the one hand by the uncertainty as to the cause of the optic nerve changes and the fact, as stated by Uhthoff, Nettleship and others, that a certain number of these patients who recover from the initial neuritis or papillitis, with a certain amount of vision, often maintain this for years.

Certainly, in the absence of other symptoms, it would require a most optimistic mind to hope for any improvement from operative interference in the presence of an optic atrophy of long standing. On the other hand, if the patient were seen during the stage of choked disc, such a procedure might be warranted rather than take the desperate chance that some vision might remain after the subsidence of the papillitis. The possibility of the subsequent development of a large cerebral hernia and its remote consequences must then be considered and assumed.

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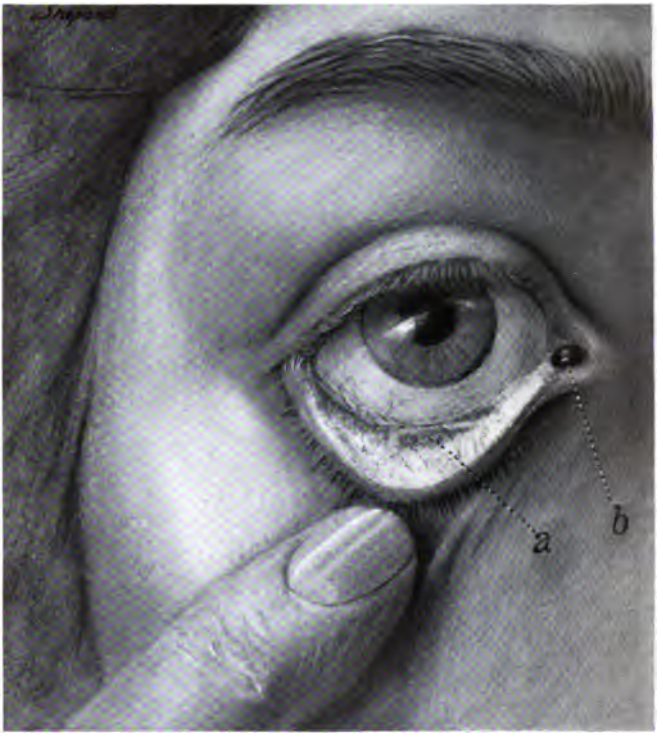


Melanosis of the conjunctiva.

DISCUSSION.

DR. ROBERT S. LAMB, Washington, D. C.: I should like to ask one question, and that is the relative position of the clinoidal spinous processes in these cases, as compared with the normal. I should like especially to know whether they leaned away from one another.

DR. T. B. HOLLOWAY: In reference to Dr. Lamb's question, I would say that much would depend upon the distortion of the wings of the sphenoid. Behr seems to have devoted more study to the relations at this portion of the skull than other observers, but I cannot recall that he emphasizes the importance of the clinoid processes. What effect the anomalous foramen, sometimes found at this point, would have, I cannot state. I refer to the bony ridge that sometimes connects the anterior and middle processes, forming the so-called carotico-clinoid foramen.

MELANOSIS OF THE CONJUNCTIVA. REPORT OF A CASE.

ROBERT L. RANDOLPH, M.D.,

Baltimore, Md.

Mrs. L. consulted me two years ago for an error of refraction which proved to be a trivial one. She had never had any inflammation of the eyes so far as she herself knew or had heard of from her parents. Her vision was perfect in both eyes. I noted that in the lower conjunctival sac of the right eye there were three patches of pigment. These patches lay in almost a straight line along the inner border of the lid and nearly invading the ocular conjunctiva. They were discrete, sharply marked, and of different sizes—the outermost one being the longer, the innermost the shorter, and both lying nearer the eyeball than the companion patch which lay well out on the lid and about midway between the inner and outer canthus. The caruncula was a much deeper black than the three patches just mentioned. In the left

eye there was one small patch of pigment in the lower conjunctival sac, and the lower half of the caruncula was black, and just as in the right eye this blackness was of the same intensity as was noted in the case of the right caruncula, the only difference being that the upper half of the left caruncula was of the normal pink red. My patient had been aware from early childhood of the existence of these black spots, and her parents told her she had always had them. The ocular conjunctiva was entirely free of any such blemish. There was no elevation of these pigmented areas, and as has been said they were only in the palpebral conjunctiva and carunculæ.

That melanosis of the conjunctiva is a very rare condition is proved by the records, there being only a few cases reported. A case has been recently reported by Beauvieux and Muratet, of Bordeaux.* In this case there was a decided pigmentation of the conjunctiva of the right eye, which pigmentation covered almost the entire outer half of the ocular conjunctiva, the condition showing no tendency to invade other parts of the surface of the eyeball or of the lids. My patient would not allow me to excise one of the patches on her lid for anatomical examination. Beauvieux was more fortunate, and secured a piece from his case for microscopic study. It was noted that the pigment was most abundant in the basal membrane of epithelium, less abundant toward the surface. The pigment was either free or included in the epithelial cells. The pigment cells were very small and often like dust in size. Deeper there were found areas containing pigment cells not unlike what one sees in the surface epithelium. The color varied in shade from straw to India ink. There seems not the slightest tendency to malignancy, and a year later there was no evidence of recurrence at the point where the piece of conjunctiva was excised. The authors seem to regard the condition as one of a variety of pigmented nevus.

**Archiv d'Ophtalmologie*, October, 1913.

Personally, I am not entirely satisfied with the explanation of the genesis of the condition, in other words, as to the origin of the pigment cells found in this situation. According to Schann and Wolfrum there exist in the conjunctiva cells which possess the property of either forming pigment or of attracting it to the edge of the protoplasm under the influence of certain causes. The slightest irritation which would produce no effect on ordinary cells would produce on these specially predisposed cells a pigmentary reaction.

DISCUSSION

DR. G. E. DE SCHWEINITZ, Philadelphia: I should like to add a case history to Dr. Randolph's interesting report. The patient, now nearly 70 years of age, has marked bilateral pigmentation in both conjunctival sacs, with patches of pigment in the semilunar folds and dark pigmentation of the caruncle, in addition to which he has large patches of pigment on each ear—the lobe, the back and the outer portion. He is one of a family with this peculiarity, which has existed in a number of generations. I think Dr. Osler, when he was Professor of Medicine at Johns Hopkins, described this family. I have not seen the other members of the family. The man himself is a subject of chronic polyarthritis, and is very lame. He came to me for the extraction of cataracts.

DR. ALEX. QUACKENBOSS, Boston, Mass.: I saw a well-marked case of this condition in 1908, in a woman sixty-eight years of age. There was marked pigmentation extending completely around the cornea. It went up to the caruncle, and also extended on to the conjunctiva of the upper and lower lid. The condition was congenital, and it was very interesting to hear the cause to which it was ascribed by sailors. The woman had been born at sea on a sailing vessel, under the Equator; and the sailors said that the condition was due to the fact that she was born under the Equator.

ACQUIRED SYMMETRICAL OPACITIES OF THE CORNEA OF UNUSUAL TYPE.*

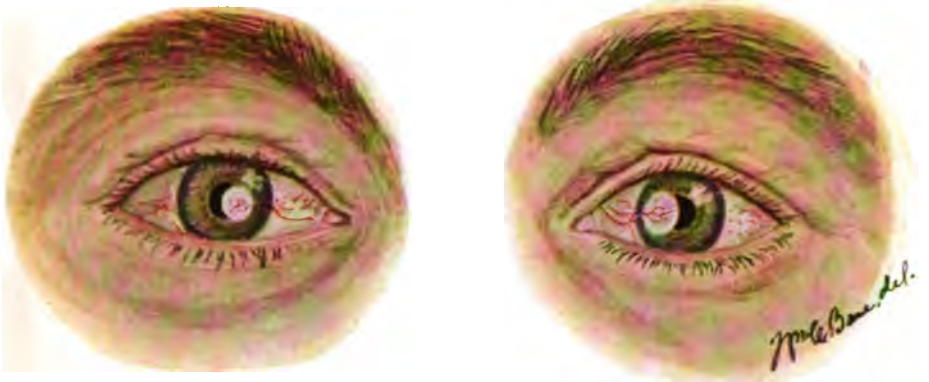
GEORGE F. LIBBY, M.D.,

Denver, Colorado.

The case herewith reported is so rare that no member of the Colorado Ophthalmological Society could recall seeing another like it, and search of ophthalmic literature has failed to find a description of the condition. While it suggests the family or hereditary type of degeneration of the cornea, most diligent inquiry has not disclosed a case of corneal involvement or even noticeably defective vision in three generations. The patient's mother died at forty-six, of Bright's disease. Her father, an old soldier who had "suffered from rheumatism" since 1865, was still living, aged seventy. There was no ascertainable tuberculosis on the paternal or maternal side.

On May 23, 1911, Dr. D. S. Schenck, of La Jara, Col., referred the patient, a woman of thirty-seven, who stated that about four years earlier her attention was first called to her eyes by daily darting pains, which had been relieved only in the past six months. A white spot appeared in the inner half of the right cornea three years after the ocular pain began, and a similar spot in the corresponding area of the left cornea was noticed six months later. The patient said that each opacity began as a crescent, concentric with the lower nasal margin of the cornea. Later she noticed the round opacity now seen in both eyes, and thought it had developed very suddenly. No history of corneal traumatism or inflammation could be elicited. Lenses of +0.37 cyl.

* This case was presented before the Colorado Ophthalmological Society, October 21, 1911, and October 18, 1913.



Acquired symmetrical opacities of the cornea of unusual type.

axis 90° were being worn without appreciable improvement of vision, but in the hope of relieving occasional frontal and deep orbital aching. The patient reported uninterrupted good health except "a little stomach trouble and female weakness," and seemed energetic and cheerful.

On examination a symmetrical opacity was seen to the nasal side of the center of each cornea, more below than above the horizontal meridian, and encroaching upon the pupillary space. The right opaque area measured 4 mm. horizontally by 4.5 mm. vertically; the left, 4.5 mm. by 5 mm. The opacities were whitish, with a faint yellowish tinge, and a few fine blood-vessels penetrated each opacity. The corneal epithelium was smooth, clear and not elevated. The substantia propria was deeply invaded. Viewed through the corneal microscope the right opacity had the appearance of a mass of closely packed cholesterin crystals, as is sometimes seen in old leukomata, which was observed in only the nasal fourth of the left opacity. A slight translucency in the central half of the opaque area in the left cornea was probably due to non-crystallization of the infiltrate in that location, the degenerative process being less advanced in that eye. The temporal fourth of this opacity was more opaque than the central zone, but it showed no crystals. Trachoma and pannus were excluded.

V. R. E., $\frac{5}{12}+$, with -0.50 sph. $\bigcirc$ $+1.50$ cyl. ax. 85° $=\frac{5}{6}$. V. L. E., $\frac{5}{12}-$, with -1.00 sph. $\bigcirc$ $+1.75$ cyl. ax. 125° $=\frac{5}{6}+$. These glasses were worn with comfort. The accommodation was 6 D. in the right eye and 4.50 D. in the left, with correcting lenses.

Calomel, grain $\frac{1}{10}$, t. i. d., caused soreness of the gums and had to be discontinued. Potassium iodide was tolerated up to 15 grains t.i.d., but not larger doses. This was administered for nearly three months, and various hygienic measures practised. An ointment of yellow oxid of mercury, 1 per cent., was massaged into the corneas, following hot applications to the eyelids every second night for two months. This was alternated with 2 per cent. dionin solution for an equal length of time. Later, $\frac{2}{5}$ per cent. of pilocarpin solution was instilled each morning and noon. These local and general therapeutic measures were of no appreciable benefit. The pilocarpin caused poorer vision and considerable distress.

When the patient next came for examination, October 21, 1911, a faint and very small opacity was observed slightly above and to the nasal side of the opaque area in the left eye. It had a fan-shaped leash of very fine vessels running into it. The opaque area in each eye seemed somewhat more vascularized, and the left one thinner at the center. The accompanying water-color drawing, for which I am much indebted to Dr. W. C. Bane, of Denver, was then made. It portrayed the condition accurately and graphically at that time. The Wassermann reaction and von Pirquet test were both negative. As Dr. T. B. Holloway* had recently reported a vascular, superficial, grayish-white infiltrate covering the lower quadrant of one cornea and completely hiding the underlying iris, which was associated with acne rosacea in a woman of twenty-nine, the somewhat roughened and slightly nodular skin of the patient's face was critically examined by Dr. A. J. Markley, who excluded acne.

In July, 1912, the opacities presented no change in appearance, but careful measurements showed slight increase in size in each eye. The right opacity was 4.5 by 5 mm., the left was 5 by 6 mm., and included the opaque spot noted at the previous examination.

In August, 1913, the opaque areas were 4.5 by 5.5 mm. in the right eye, the left being 6 by 6 mm., while in October of that year the right measured 5 by 6 mm., the left 6 by 6.5 mm. At this time the right opacity showed a faint spreading, deep in the substantia propria. The refraction, measured each time with and without cycloplegia, was now changed to R. E., -0.50 sph. $\bigcirc +1.50$ cyl. ax. 120°; L. E., $+1.25$ cyl. ax. 105°. The vision with this correction was $\frac{5}{9}-$ in the right eye, $\frac{5}{6}-$ in the left, and $\frac{5}{5}-$ with both eyes used together. As the sunlight annoyed her, possibly because of reflection from the pupillary margins of the opacities, the lenses were ground in the Euphos glass of lightest tint.

The patient now stated that twelve years before she had a miscarriage, and that a baby born in December, 1912, had died just six months later from "lack of vitality from the day of its birth." These occurrences suggest syphilis in the mother, affecting her issue disastrously.

* Archiv. of Ophthalmology, 1910, vol. xxxix, p. 321.

In consultation, Dr. Edward Jackson expressed the opinion that the opaque tissue arose from the deepest portion of the cornea and extended through, but not between, the corneal layers. The distribution of the fibrils of opacity resembled the petals of a crysanthemum, when the flower is seen from above. He advised against operative interference, but suggested that an optical iridectomy might be done later.

Dr. Wendell Reber* describes "A Case of Hyaline Degeneration of the Cornea," illustrated by a fine colored plate. While the appearance somewhat resembles the opacities above described, it was monocular and appeared on the day following slight injury from a flying particle while riding in a train. It was described as a milky-white spot occupying the upper quadrant of the cornea. When first seen by Reber, nearly four months after its appearance, it was 5 by 7 mm. in size, of an old ivory hue, was smoothly covered by epithelium, and reached to the lower third of the pupillary area. V. $=\frac{5}{15}$. Three fine vessels passed into it at the upper limbus of the cornea, the middle portion of the opacity seemed faintly lobulated, and the lower edge was shown to be distinctly crenated when examined with the binocular magnifier. After sixteen months the infiltrate had extended to the lower border of the pupil, was circular in shape, and much more vascular at the upper margin. When examined two years later, the only change noted was a thin 1.5 mm. zone, in advance of the yellow area, below. Tubercular causation was suspected but not proved. Local and constitutional treatment proved unavailing.

Dr. J. Rubert, of Kieff,† describes three cases of "Hyaline Degeneration of the Cornea," and refers to one reported by Berlin in 1887 and one by Gallenga in 1894, with microscopic

* Ophthalmic Record, Dec., 1911.

† Archiv. of Ophthalmology, 1910, vol. xxxix, p. 341, with four colored plates in the German edition, February, 1910.

findings. The common characteristics of these five cases are that each began at or near the upper corneal margin, gradually and without irritation involved about half the cornea except in one case in which nearly all the cornea was invaded, showed slight nodular elevation of the epithelium and was associated with trachoma or pannus. One case occurred in a male, four in females, and their ages were from ten to twenty-two years. Three right eyes were affected, and one left eye, in four cases. In the fifth case both eyes were involved. Rubert dissected up the superficial layer of the cornea from below the infiltrate in one case, excised the altered tissue, and replaced the flap. Healing by primary union occurred; and vision rose from 0.1 to 0.2. In all the other cases no treatment was found that benefited the condition. Microscopically, the notable changes were thickened corneal epithelium, absence of Bowman's membrane, degeneration of all normal corneal elements, and thickened vessel walls with loss of endothelium. Rubert believed that these degenerated vessel walls were the starting-point of the hyaline degeneration of the cornea in his cases. The colored plate (Tafel I) in Rubert's article shows that the dense opaque tissue entirely obscured the upper corneal margin, which is faintly discernible in Reber's case. In the author's patient the right eye showed a strip of clear cornea 2.5 mm. in width at the nasal limbus, where the opacity approached most nearly to the border of the cornea, while the left presented 1 mm. of clear cornea.

Dr. J. M. Ball* states that he "observed one case of symmetrically placed tumors of the corneæ which histologic examination showed to be fibromata." No further description and no picture of the condition is given.

From Dr. G. A. Berry's book† the following is a full quotation:

* Modern Ophthalmology, 1904, p. 305.

† Diseases of the Eye, 1893, p. 147.

"Fibroma of the Cornea.—This is an exceedingly rare affection. It occurs as a flat growth of densely white appearance, involving the superficial portion of the cornea, over the whole of which it very slowly spreads. When met with before it has involved the whole cornea it should be removed by slicing off layer after layer until the transparent tissue below it is reached."

Dr. Berry's colored illustration bears some resemblance to the sketch presented by the essayist, but the opaque area appears to be thicker and whiter and passes over the corneal margin into the sclera.

After carefully reviewing all of these cases the writer is of the opinion that his case is essentially different. It may be allied to the group known as family degeneration of the cornea of which, however, it would present a new type; or it may be a specific lesion, although the evidence of syphilis is inconclusive. Although the sensibility of the cornea was normal, the binocular darting pains which preceded the appearance of the opacities might suggest a nerve element in the causation.

DISCUSSION.

DR. G. E. DE SCHWEINITZ, Philadelphia: I have not observed a condition exactly similar to the one Dr. Libby describes. I have a patient, a man of fifty-six years, whose business at one time required him to be much exposed to the heat of open furnaces. He developed, when about thirty-six years of age (twenty years ago), a symmetrical crescentic patch on each cornea, in the upper part. Each lesion is glistening, yellowish-white and without vascularization. They give the patient no inconvenience and are hidden, for the most part, by the ordinary position of the lids. He has normal vision, and is a normal man in every other way. A somewhat similar lesion, but in one eye only, I have observed in a Hebrew woman. All examinations, for tuberculosis, syphilis, etc., were negative. In neither of the patients to whom I have referred is there any family history

of corneal affection. I assume that lesions of this character, and perhaps those described by Dr. Libby, should be classed among the corneal dystrophies.

DR. C. F. CLARK, Columbus, Ohio: It is possible that the case I am about to describe does not belong in the class of cases under consideration. It was a case of dystrophy of the cornea that I reported a number of years ago, which produced thirty diopters of astigmatism. There was a groove-like break near the upper border of the cornea. The man was a locomotive engineer, and this condition greatly impaired his vision. From thirty diopters the astigmatism was reduced to five diopters by the application of the galvano-cautery to the whole length of the groove. He had the same condition but to a less degree in the other eye. It developed without any cause that he could discover.

DR. GEO. F. LIBBY, Denver: With regard to this case I have debated in my own mind between some type of hereditary corneal degeneration (which, of course, cannot be proved), and the possibility of a syphilitic lesion. There are so many manifestations of the latter that I think we are pretty apt to fall back on that when we are unable, as I am in this case, to explain the causation and classification of obscure conditions.

There are three other points of special interest that I would like to emphasize. The corneal epithelium is unaffected. On the other hand, all the changes are in the substance proper of the cornea; beginning at the inner layer, and penetrating at right angles to or towards the outer layer of the substantia propria. The third point is the tissue changes that have occurred in the opacities. Cholesterin formation has, apparently, proceeded through the entire opacity in the right eye, partially in that of the left eye; and cholesterin crystals indicate a degenerative process.

The condition of the eyes at the present time is just about as pictured in the drawing, except that each opacity is a millimeter or a millimeter and a half larger in vertical or horizontal diameter than when the drawing was made. The sight is almost as good as at first. There is no elevation of the epithelium and it never has been rough, and I do not think there is dystrophy of the epithelium.

BLEPHAROCHALASIS—REPORT OF TWO CASES.

EDWARD STIEREN, M.D.,
Pittsburgh, Penna.

In the Section on Ophthalmology of the American Medical Association, session of 1913, Dr. W. B. Weidler, of New York, presented a comprehensive paper on blepharochalasis, reporting therein two cases observed by himself with the microscopic findings.

Although this condition was recognized as an ophthalmological entity as early as 1854, having been described by MacKenzie in his celebrated work on Diseases of the Eye, the credit of applying to it the descriptive term of "blepharochalasis" belongs to Fuchs, who, in 1896, reported a series of cases in the *Wiener klinische Wochenschrift* under this title.

As Weidler observes, many terms have been used to define this peculiar condition, but blepharochalasis is undoubtedly the most descriptive one, giving at once an idea of edema, stretching, thinning and atony of the skin and subcutaneous tissues of the lid.

In the two cases occurring under my observation, one, far advanced, has come to operation with histologic study of the excised tissues. The second case may be regarded as being in a state of suspension. At any rate it has not advanced perceptibly within the past year, there not yet having appeared under the lax integument the collections of adipose tissue which typified my first case.

Case 1. Miss R. W., domestic, aged nineteen, German. Has had the usual diseases of childhood. Began to menstruate at twelve years of age. Is not certain but believes

swelling of lids began about the same time. Condition October 14, 1911: Much redundant tissue of upper lids, especially left, which droops almost to ciliary margin. Corneæ and media clear. Pupils responsive. Tension normal in each eye. V. R. E., $\frac{2}{10}$; V. L. E., $\frac{6}{6}$. Refraction under homatropin: R. E., -1.50 sph. $\bigcirc -1.50$ cyl. ax. $180° = \frac{6}{10}$; L. E., $+0.75$ S. $= \frac{6}{5}$.

Right fundus: Moderate physiological cupping of disc, atrophic on the temporal side; left fundus, moderate physiological cup.

The true nature of the palpebral affection was not recognized at this time, although it was proposed to excise the redundant tissue, to which patient would not consent. A full correction was ordered and the patient was lost sight of for two years.

October 9, 1913, the patient reappeared mainly on account of the troublesome condition of the upper lids, especially the left, which, according to her statement, would cover the eye completely and interfere with vision when stooping over, particularly on wash-days when bending over the tubs. The photograph (Fig. 1) was taken at this time. Upon examination the redundancy of the upper lids was found to be markedly increased, the left hanging down so far as to cover the lashes in the center and outer third of the lid. The integument was rough, scaly and so lax that it could readily be stretched over the lower lid. The skin did not pit on pressure but the tissues had a boggy feel when pinched between the fingers. Subcutaneous masses, not present two years earlier, could readily be felt and could be reduced backward into the orbit, only to prolapse again when pressure was removed. When so reduced the skin had the characteristic wrinkled tissue-paper appearance described by Fuchs. The color of both upper lids was a dim purple, in marked contrast to the general florid complexion of the patient's face.

The right upper lid did not present so great a degree of redundancy as the left, the fulness being most marked at the outer half, but the character of the integument in regard to color, laxness and wrinkling was the same.

The subcutaneous contents, especially in the outer portion, seemed firmer than those of the left lid, suggesting the consistency of glandular tissue.

Fig. 1.—Case 1. Before operation.

Fig. 2.—Case 1. Four months after operation.

3.—Case 2. Illustrating the atonic fold of integument projecting below the sulcus.

Fig. 4.—Case 2. Illustrating the laxness of the atonic integument.

Fig. 5.—Upper right lid of Case 2, illustrating the "wrinkled tissue-paper" appearance of Fuchs of the integument.

A Wassermann test and search for the *filaria sanguinis hominis* both proving negative, the lids were operated upon October 28, 1913. The brows having been shaved, an incision was made along the full length of the under surface of the rim of the left orbit. A second incision began at the inner end of the first incision and swept downward to include all the redundant tissue, meeting the outer end of the first incision. The integument and subcutaneous tissue thus outlined was excised, the elliptical piece measuring 5 cm. long by 2.5 cm. wide at its center. Hemorrhage from the cellular tissue was free and of an oozing character, but could readily be controlled with hot compresses. As the dissection was continued, soon a long narrow nest of adipose tissue in a capsule was uncovered. This was removed only to be followed by others until five such nests of fat, which came from the upper and outer part of the orbit, had been excised. The lacrimal gland was found to be firmly attached in its fossa. After all the adipose tissue that could be found had been removed the remaining cellular tissue was gathered together deeply and sutured to the periosteum of the orbit with No. 0 chromic catgut. The incisions in the integument were coapted neatly with a continuous silk suture, the line of the incision falling into the natural sulcus of the lid as illustrated in the photograph (Fig. 2) taken four months after operation.

The operation on the right eye consisted of an incision beginning at the inner third of the under surface of the rim of the orbit and carried outward and downward following the rim to its outer angle. A second incision was then made to include all the redundant integument; the flap dissected off was shorter but slightly broader than the flap removed from the left lid. The hemorrhage met with was similar to that of the left eye and three nests of adipose tissue were found and removed. The lacrimal gland on this side was found to be prolapsed, accounting for the firmer consistency of the right upper lid than the left. The superior or major lacrimal gland was removed, rather free hemorrhage occurring from the lacrimal artery, which was tied with catgut. The same suturing precautions, both deep and cutaneous, were observed as on the left side and union was prompt and uneventful. The cutaneous sutures were removed on the eighth day.

Microscopic examination: The excised tissues consisting of skin, subcutaneous cellular tissue, adipose tissue and lacrimal gland were submitted for microscopical examination. Technic: 4 per cent. formalin solution. Hematoxylin and eosin. Weigert's elastic tissue stain. The *stratum corneum* in places was markedly thickened, the flat epithelial cells occurring in many layers. In the *corium* there was complete absence of adipose tissue and general atrophy or absence of the papillæ.

The *stratum reticulare*, in sections stained with Weigert's special stain, was poor in elastic fibers, showing a general atrophy and in many places disappearance of elastic tissue. The subcutaneous cellular tissue showed wide separation of the fibers, many of them crowded together, with enormous spaces between, suggesting a preëxisting state of intense edema.

The walls of the blood-vessels were uniformly rich in spindle connective-tissue cells. Those which ordinarily should be of capillary type had an adventitia one or two cells broad. In short, there was a general hyperplastic condition of the cutaneous vessels with a marked increase in their number. Sections from the various nests of fat revealed no increase in blood-vessels and, in those sections to which the enveloping membrane had still adhered, the membrane was simply connective tissue. The tissue in the sections from the gland removed from the right orbit was normal lacrimal gland, with possibly a slight increase of adipose tissue between the lobules and equally slight hyperplasia of glandular elements.

The cosmetic result has been very satisfactory (Fig. 2). The mechanical ptosis is cured, but the integument from the brow to the ciliary border of the lids will take on the peculiar purplish hue, referred to above, during menstrual periods.

Case 2. Miss M. C., schoolgirl, aged fourteen, American. Had measles when two years old, chicken-pox and whooping-cough between six and seven years of age, mumps when eight years old. Began to menstruate between her eleventh and twelfth year. When about eleven years old patient had an attack of dizziness and headache, resembling a bilious at-

tack, which lasted about two days, at which time the lids first became swollen. There have been several subsequent attacks of swelling since then but none within the past year, during which time she has been under my observation. The patient is a well-nourished, full-breasted girl, with a sallow complexion and acne vulgaris of the face. She is not of a nervous temperament and is studiously inclined.

The appearance of the upper right lid is that of ptosis of the inner half of the lid. The upper left lid droops slightly, apparent only on close inspection. The peculiar feature, however, is the extremely lax condition of the upper lid integument and its characteristic wrinkled tissue-paper appearance. In the left lid this area of wrinkled skin is small, about the diameter of an ordinary lead-pencil. In the right lid this is much more extensive, the area of wrinkled skin being forced outward in a fold when the lid is raised (Fig. 3). The degree to which the skin can be stretched is inadequately illustrated in the photograph (Fig. 4), as the amount of stretching here illustrated represents only about half; it can actually be stretched to the lower rim of the orbit. The wrinkled tissue-paper appearance of Fuchs is well illustrated in the enlarged photograph (Fig. 5) of the right lid. The skin of either lid when pinched between the fingers is felt to be thin, with very little underlying connective tissue.

There are no masses of any sort that can be felt either by pinching or by palpating the lids, but on introducing the tip of the little finger well under the rim of the orbit above, a rounded elongated mass can be felt and mapped out on each side. It will probably be only a matter of time until these masses, which are undoubtedly adipose tissue, will prolapse into the loose cellular tissue of the upper lids.

From my observations of these two cases, profiting by the reports of Weidler and his review of the literature on the subject, I am strongly of the opinion that blepharochalasis begins with an edema of the subcutaneous tissues of the upper lid, not unlikely an angioneurotic edema, as Fuchs states, and that either recurring attacks or a degenerative process follows which attacks the true skin as well as the connective tissue framework of the subcutaneous tissues. This was

the condition of the upper lids of my first case two years and a half ago and is the present condition of Case 2. As the atrophic process advances there results a hernia of the orbital fat or proptosis of the lacrimal gland, due to lack of support in the subcutaneous connective tissue.

Rollet and Grenet,* reporting a case of bilateral blepharochalasis, remark on the elusiveness of the orbital tumor which had prolapsed under the skin of the lids, referring to it as a veritable *souris orbitaire*, indicating to them that the fat was not attached but that it came from the orbit.

In a case reported by W. McL. Ayres† no hernia of fat is mentioned. In his case the area of atrophy of the skin was most marked at the outer canthi of both eyes, extending down partially on each lower lid. In this site a hernia of fat would not be so prone to occur as in the more spacious upper part of the orbit.

It is my intention to keep under observation my second case and to note if hernia of fat finally occurs. Certainly there is a mass which can be felt under the upper rim of the orbit in each eye now and which in my opinion is orbital fat held back only by the palpebral fascia.

The results from operation should be good if care be taken to close the supraocular space by suturing the remaining orbital fascia to the periorbita.

The primary incision in the lid should be made in the sulcus and a little more than the amount of integument that seems necessary to correct the fulness of the upper lid should be excised.

Great care should be taken to check and control hemorrhage in all stages of the operation, so that no blood is allowed to drain into the orbit. With a perfectly aseptic and dry operation, union should be prompt and the result permanent.

* *Clin. Ophth.*, xix, p. 535.
† *Lancet Clinic*, December 13, 1913.

DISCUSSION.

DR. S. LEWIS ZIEGLER, Philadelphia: I wish to discuss this paper, because of several unusual cases that I have seen. I believe that this condition is a reflex neurosis from a lesion of the sympathetic, located as a rule on the septum of the nose. I base this conclusion on certain disturbances that followed an intra-nasal operation in the hands of a colleague, and another that followed an intra-nasal operation of my own. Both were on the septum, and both were made on the lower or median portion of the septum. My own case cleared up entirely, a year later, through a cauterization of the upper portion of the septum. All the marked condition of blepharochalasis disappeared, and the man was congratulated by his friends on his youthful appearance. It made a great change in his facial characteristics. The other case did not clear up so markedly, but it did improve. These lipomatous deposits seem to be a hyperplastic change due to some disturbance in the lymphatics. Nevertheless, I am convinced that a sympathetic lesion is the origin. Otherwise, I do not see how so marked a deformity could change and clear up as it does. My cases were quite pronounced ones. I think the subject is worthy of study in this relation; if the rhinologists could be interested in the subject and asked to keep track of such conditions, as they are observed, we might secure further information on the matter.

DR. EDWARD STIEREN, Pittsburg, Pa.: I agree with Dr. Ziegler that the origin of these cases is probably a sympathetic neurosis. All the cases that have been reported came on apparently just about the first menstrual period; and in this case of mine, there was a general change in all the superficial vessels, suggesting a sympathetic involvement, as evinced by the increased caliber of the vessels. Regarding the two cases reported by Dr. Ziegler, I think that they may have been simply angioneurotic edema, disappearing without leaving any trace afterwards.

A CASE OF CHRONIC SPOROTRICHOSIS OF THE EYE.

ARTHUR J. BEDELL, M.D.,

Albany, N. Y.

On December 18, 1913, Mr. C. S. A., aged forty-nine, a hotel manager, consulted me because of a constant discharge from his right eye which had lasted two years and which persisted despite various treatments given by several physicians. In 1910 the eye began to annoy him, but it was not until July, 1911, while in a New York City hospital for an appendectomy, that the condition became so severe as to demand treatment. All sorts of solutions have been used in his eye since that time.

On examination, the skin of the right eyelids was congested. There was an irregular conjunctival mass 7 mm. by 5 mm. by 2 mm. to the nasal side of the upper right lid extending 2 mm. beyond the ciliary margin. This was much like ordinary granulation tissue in appearance, structure and relation to the conjunctiva. The entire palpebral conjunctiva, especially the inner half of both upper and lower lids, was congested with many discrete follicles and numerous 1 mm. ulcerating points. These ulcers were shallow, yellowish-gray areas. The inner half of the bulbar conjunctiva was congested with several enlarged follicles. The caruncular fold was three times its normal thickness and uniformly infiltrated. Both puncta were prominent and dilated and the inner canthus flooded with yellow, somewhat tenacious mucopus. After thorough irrigation the discharge would quickly re-form. Pressure on the lacrimal sac caused no regurgitation nor was there any fulness over it. The corneal epithelium was lost over an irregular 4 mm. area to the nasal side of the apex. Pupil 3 mm. active to light and accommodation; disc clearly outlined; no fundus lesion. V. R. E., = $\frac{20}{70}$; L. E., = $\frac{20}{70}$. Conjunctiva and fundus negative.

Cultures were taken by Dr. James F. Rooney, but while waiting for a report treatment was started, as the case was considered to be in all probability sporotrichosis, and this was positively proved later. Wassermann reaction negative.

On January 26, after having been on saturated solution of potassium iodid, 1 gram three times a day, he was sent to the Albany Hospital. The granulation from upper lid and the caruncular fold were both removed and sent to the Bender Laboratory, from which Dr. Harry S. Bernstein reports:

"Specimen consists of two fragments of soft tissue, the largest of which measures 2 mm. by 1.5 mm. Microscopic examination shows the presence of a stratified squamous epithelium with a dense subjacent infiltration of cells. The epithelium of the larger fragment is edematous. A moderate number of polymorphonuclear leukocytes are found among the epithelial cells. Plasma cells, small and large lymphocytes in close apposition with a few intersecting bundles of connective tissue cells, form the dense subepithelial infiltration. An occasional plasma cell contains two nuclei. A rare prelymphocyte is seen. Diagnosis: Subacute and chronic inflammation. Lymphoma cannot be excluded."

On February 1 the inferior and superior right ducts were opened, and five firm brown concretions were removed from the ducts and sac, after which the sac was thoroughly curetted. These concretions ranged in size from 1.5 mm. in diameter to an oval 2 by 6 mm. The sporotrichum was found in culture after crushing these. The entire conjunctival surface was painted daily with tincture of iodin, and a saturated solution of potassium iodid was given in 2 gram doses three times a day.

Recovery was uneventful. The small ulcers quickly healed, no new ones presented, and the lids were entirely smooth by February 10, since which time there has been no secretion and practically no lacrimation.

The length of time the condition had lasted, the severity of infection, and the complete recovery, are points of interest in this case. With the correcting lenses the patient has vision of $\frac{20}{15}$, and easily reads Jaeger 1. At no time was the

left eye involved, although the right discharged so freely that the pus literally ran down the cheek. It is not possible to state the definite time of infection. Although the patient was in a hospital when the eye became decidedly worse, no attention was paid to the ocular condition, and it is therefore impossible to tell whether he had constitutional symptoms; as far as known he had no marked glandular involvement at that time. Many smears were made from his conjunctival discharge, but seemingly no cultures taken.

In a careful study of reports from the United States, ocular involvement has been noted twice—Gifford's case of definite conjunctival symptoms diagnosed by finding the sporotrichum in the conjunctival secretion, and Wilder's of infection while working with sporotrichial cultures.

Ruediger, in his analysis, finds that most of the United States cases have been confined to the Western States, especially the Missouri valley. My patient has proved that he has not been West for many years, practically spending all of his time between New York City in the winter and the St. Lawrence river in the summer.

The appended bibliography will show that any and every part of an eye has been affected in human patients as well as in laboratory experiments; suffice it, therefore, to call attention to the titles of the recorded articles.

The commonest sites of infection are the lower and upper lids, the cornea, and the iris. Conjunctival discharge varies. In only two other cases was the secretion profuse, although several histories make no mention of the amount, and still more fail to describe the character of even the little noted.

My object in reporting this case is, *first*, it is the third ocular infection reported in the United States, and *second*, because of its clinical suggestion of tubercular, luetic, or Parinaud's conjunctivitis, with the remote possibility of mistaking it for trachoma.

It may be easily differentiated by finding the typical

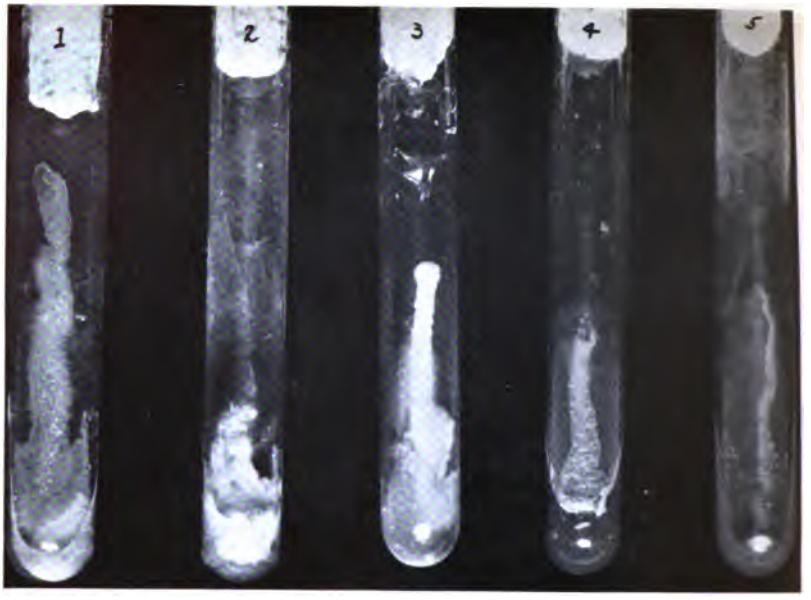


Fig. 1.—1, Four weeks old, blastomycetic type, Saboureaud's; 2, Six weeks old, blastomycetic type, lactose litmus agar; 3, Three weeks old, type B, Saboureaud's; 4, Three weeks old, type B, Saboureaud's; 5, Ten weeks old, type A, Saboureaud's.

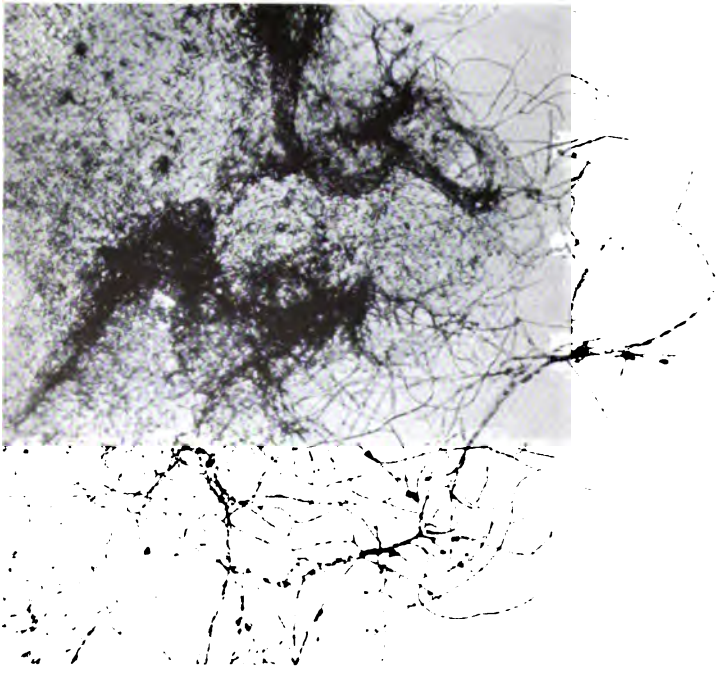


Fig. 3.—Masses mycelium and spores. Levulose bullion, unstained. B. & L. 2/3 x 250.

organism and by a negative tuberculin or Wassermann reaction. The culture will be of great assistance in the acute form of sporotrichial infection, as the clinical resemblance to Parinaud's conjunctivitis is marked.

It is very probable that other cases have been seen and classed as lues because they were cured by the use of iodids.

BACTERIOLOGICAL REPORT BY DRS. JAMES F. ROONEY AND LAWRENCE R. WORRELL.

The first cultures were taken December 18, 1913, on nutrient agar and blood serum and showed no growth after five days.

Second cultures incubated at 37° C. showed visible growth after five days in the form of minute transparent colonies, separate, slightly raised, circular in outline, circumference smooth (not rayed), and having an almost uniform diameter of approximately 0.4 mm. Growth progressed very slowly, and the cultures were removed from the thermostat at the end of the eighth day; subsequent growth was at room temperature. At an average temperature of 20° C., growth was more rapid than at 37° C., although slow at best. There was little tendency to confluence until the colonies had attained a diameter of approximately 2 mm., and then the edges of the separate colonies simply merged, those on the edge of the streak retaining their individuality. In the primary cultures growth practically became stationary after the streak reached a diameter of four millimeters.

Secondary growths were made on the sugar agars, plain agar, sugar litmus agars, gelatin, plain broth and sugar broths in fermentation tubes, potato, and litmus milk.

Secondary growth resembled in all particulars the character of the primary culture except for increased rapidity, the first colonies being apparent at the end of from forty-eight to fifty-six hours. Growth was more luxuriant upon the sugar agars, and of these especially on the maltose agar. Growth was more rapid at room temperature than in the thermostat as in the original cultures, although an incubation for twenty-four hours and subsequent growth at room temperature gave best results.

Growth on Saboureaud's medium was no more luxuriant than on the sugar agars and no different in character.

In plain bouillon growth was scanty, flocculate and slightly granular, mainly at bottom of tube, no pellicle, no general clouding.

In sugar broths growth was more profuse than in plain broth and of the same character, but with tendency to form longer strings. No fermentation of any of the sugars used, viz.: saccharose, dextrose, levulose, maltose, lactose. No fermentation of inulin or starch. No fermentation of glycerin. Sugar litmus agars showed acidity in some tubes but not in all. On potato the growth was transparent, forming a crinkled veil over the surface of the medium with a crinkled pellicle upon the water in the bottom of the tube.

Milk was neither acidified nor coagulated and growth was very scanty.

Gelatin not liquefied. Organism is a strict aërobe.

A subculture, taken from a six weeks' old bouillon culture, gave upon agar, Saboureaud's medium and the sugar agars a surprising difference in appearance. Growth was luxuriant, very rapid, moist and glistening, at first smooth, with elevated margin which was itself smooth and of regular symmetrical outline. The color was at first a pale whitish yellow; about the fifth day a tendency toward a green-brown began, and then the whole streak darkened, assuming after the fifteenth to twentieth day a distinct dark brown color. At an early stage of the darkening of the colony the medium commenced to be stained and gradually assumed a very dark brown appearance, somewhat lighter, however, than the colony itself. This change in the medium began in the upper part of the tube synchronously with the deepening of the color of the colony and gradually progressed downward, finally leaving all the medium a deep coffee color. After ten or twelve transplants the smooth or slightly papulate appearance of the growth was lost, and it began to assume a wrinkled appearance with irregularly arranged circinate ridges and furrows, dry, dull and opaque. Gelatin was slowly liquefied. This change occurred upon the second transplant from agar to Saboureaud's medium.

At present the character of the two subvarieties upon Saboureaud's medium is entirely dissimilar. The first

Fig. 4.—Ten days' culture, Saboureaud's, Gram stain. Mycelium long and short segments, moderate branching chlamydo and artho spores. Diffence staining mycelium. Gram negative G+ granules. B. L., 1/12 x 600.

Fig. 2.—Levulose bullion. Filament and spores. Eight weeks. B. & L. Oc., 1 x 900, unstained.

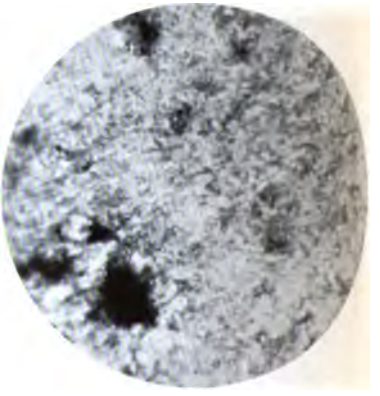


Fig. 5.—Short mycelium and fusiform bodies, third transplant from stain. B. L., 1/12 x 600, type A.

shows a scanty growth made up of minute transparent colonies coalescent slowly and with a circinate margin. The color is grayish-white with a porcelain-like appearance in older growths, and the margin becomes minutely fimbriate. There is little growth in the water of condensation. The other shows a luxuriantly rapid growth, yellowish in color, smooth and glistening, yeast-like in consistency and with a smooth linear margin. The color rapidly darkens, especially on exposure to the light, and becomes brown with staining of the medium of growth. The water of condensation becomes filled with a pasty, yeast-like mass.

Microscopically the unstained smear shows abundant double contoured long and short threads, granular, septate, branching. The diameter of these threads varies from 0.5 micron to 2.5 micra, the diameter, however, being constant in the same culture. Spores are both round and apiculate, and in the early cultures there were innumerable highly refractile homogeneous fusiform bodies of double contour lying free about the mycelium, but unattached to it, approximately 1.0 by 2.5 micra. The septa are of varying length and are more apparent and frequent the older the culture. Chlamydospores are uncommon but occur and are both terminal and integral. When chlamydospores are found they are usually in pairs and occupy adjacent sides of a septum. The Eco spores are most commonly lateral, although some subcultures show a chain of spores at the terminus of a filament. They are attached by short and thin sterigmata to the mycelium.

The mycelium generally is Gram negative, although the granules which are usually massed at the poles of the separate elements of the mycelium retain the violet of the stain, as do many of the finer granules in the mycelium. The spores are also Gram positive. The young, incompletely septate mycelium is uniformly and homogeneously Gram positive. The limiting membrane of the mycelium does not appear to stain. The septa seem to have a minute operculum by means of which there is continuity of protoplasm throughout the filament. The fusiform bodies just described do not take either the violet or the pyronin of the counterstain and remain unstained by all the common dyes.

The organism is not acid-fast, decolorizing readily by

either alcohol or acids after carbolfuchsin. It stains rather poorly by Loeffler's solution. The protoplasm with Wright's stain is basophile, the polar masses tending to take the azure of the stain, although rather weakly.

Conclusion: The organism is composed of a branching spore-bearing mycelium which is septate and granular, together with fusiform bodies of uncertain origin, resembling the bodies described by DeBeurmann as occurring within the tissues of artificially infected animals and in the pus from human infections. The spores are most commonly isolated and attached to the mycelium by a short and thin sterigma.

It is Gram negative and non-acid-fast. Morphologically it conforms with Link's definition of the botanic group, *Sporotrichum*. Culturally it shows marked differences from any of the previously described varieties and their pleomorphisms, although seeming closer to the Schenck type as concerns color and sparseness of growth and to the DeBeurmann type as concerns cultural and morphological pleomorphism. The organism is still being studied as to its pathogenicity for animals as well as its further cultural characteristics.

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CONTRACTION OF THE FRONTALIS IN ABDUCTION OF THE EYEBALL.

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Philadelphia.

Several different groups of cases have been reported in which muscles, ordinarily not acting together or not having the same nuclear origin of control, have been associated in action.

Such cases have been classified by Friedenwald as follows:

1. Contraction of the levator palpebræ superior with the act of moving the jaw or in swallowing.

2. Contraction of the orbicularis associated with movements of the jaw or contraction of the various face muscles (after facial paralysis).

3 Contraction of the levator palpebræ superior associated with abduction or adduction of the eye.

To these I would add—

4. Contraction of the frontalis associated with abduction of the eye.

The cases may be either congenital or acquired and may or may not occur in connection with palsies or anomalous development or insertion of the ocular muscles. Marcus Gunn was the first to call attention to the phenomena seen in the first group, to which the term "jaw winking" has been applied. In nearly all of these cases it has been found that lateral movements of the jaws were accompanied by elevation of the upper lid on one side, the other side remaining still. Similar lid-winking has been observed in opening of the mouth and in swallowing.

The committee appointed by the Ophthalmological

Society of the United Kingdom to report on Gunn's case gave as its opinion that the phenomena were to be explained by innervation of the levator both from the nucleus of the third nerve and the external pterygoid portion of the nucleus of the fifth nerve.

In Harlan's (G.) case the behavior of the lids was somewhat different. During mastication there was rapid winking of the left eye which gave the impression of a blepharospasm. It was an acquired condition in a child four years of age and followed an attack of typhoid fever.

Harman believes that these cases represent atavistic anomalies, as in the shark the fifth and the seventh nerves are so closely associated that they are called the "facial complex." Harlan considered this a logical explanation and accepted it for his case.

As illustrating the second group, Harman's observation, that elevation of the alæ of the nose accompanied normal blinking of the eyes in 20 per cent. of persons examined, may be mentioned. Topolanski has made a similar observation. He has seen a large number of cases in which, when the orbicularis of the eyes was contracted, a simultaneous vertical fold appeared at the wing of the nose on the same side, the result of contraction of the levator alæ nasi. His explanation is that the lateral portion of the malar muscle (quadrati labii superioris) reaches down to the wing of the nose, and that the anatomic association between these two muscles occasions the simultaneous contraction of the lids and the wing of the nose.

The third group contains a class of cases with a distinct syndrome. According to Duane, who has carefully analyzed these symptoms, there is a deficiency in abduction and adduction, with a retraction of the globe, narrowing of the palpebral fissure and oblique movements of the eye. He states that Turk's theory is that the retraction in these cases is due to the inextensibility of the external rectus and this

Duane believes also explains the absence of adduction and insufficiency of convergence. Others believe that the retraction is due to insertion of the internus too far back, and, as in some of the lower animals the internus is inserted on the posterior aspect of the globe, it is looked upon by them as an atavistic anomaly. The oblique movements of the globe Duane considers to be due to excessive spasmodic contracture of the inferior oblique. Parker attributes the closure of the palpebral fissure to some peculiar associated movement produced by synergic action of the facial and oculomotor nerves.

This group also contains the cases to which Fuchs probably first called attention. In some instances the upper lid is raised in attempts at adduction and falls in abduction, while in others the phenomena are the reverse of this, while in still others (but one instance so far reported) there is a relaxation of one lid in adduction and of the other lid in abduction. There may be paralysis of the interni or of the externi, or of both, and usually there is ptosis. Fuchs considers that these associated movements are similar to the involuntary movements which occur in paralysis of muscles of the extremities, and may be accounted for by assuming that the excessive nerve energy which is supplied to the paralyzed nerve overflows into the neighboring nuclei.

The anomalous associated movements present in the case about to be described seem to be of rare occurrence, the only other instance found by me being that recorded by Wilbrand and Sänger in "Die Neurologie des Auges," which is in many particulars like my own. The following is a description of my own case:

H. L., male, Hebrew, aged twenty years, single, employed as shipping clerk, came to Wills Hospital February 7, 1914, to have his left eye straightened. It had turned in since infancy. He thinks that the sight has failed some in this

eye in recent years. He has had no serious illness, and is at present in good health. He is well built and well nourished, and presents an unusually symmetrical face and skull. There is an esotropia of 12°, the right eye being the fixing eye (Fig. 1). The irides react normally to light and convergence. In movements of the eyes to the left there is marked limitation of the excursion of the left eye unless he is made to fix intently, when the excursion becomes almost full. When the eyes are turned towards the right, there is slight limitation of the outward excursion of the right eye (Fig. 2). As the fixing object is carried to the left, the left eye halts when it reaches the median line, and the elevation of the left brow begins as soon as the external rectus begins the outward rotation of the globe and reaches its maximum, when the eye by forced action reaches the external canthus. The elevation of the brow is most marked in its outer third (Fig. 3). This contraction of the frontalis is not accompanied by either an elevation of the lid or a widening of the palpebral fissure. In attention, in the primary position, in looking to the right and in looking up, there is a just noticeable tremor of the eyebrows at the root of the nose. There is no secondary deviation. When the right eye is closed and the left eye made to fixate, the outward excursion of the left eye is quite as full as that of the right when looking to the right. In adduction, the right eye is also slightly infraducted. There is no ptosis and no palsies of any of the ocular muscles.

The ophthalmoscopic examination shows: O. D. Pinhead-sized congenital opacity on the posterior capsule of the lens, disc round, no noticeable changes in the fundus, H. = 3.5 to 4 D. O. S. Media clear, disc oval, axis 105°, H. = 5 to 6 D. V. O. D., $\frac{6}{6}$. O. S., $\frac{3}{40}$. O. D. +4 sph. ⊂+0.25 cyl. ax. 180° = $\frac{6}{6}$; O. S. +4 sph. ⊂1 cyl. ax. 180° = $\frac{6}{20}$.

Dr. T. H. Weisenburg, who kindly made the neurological examination, reported that the findings were negative. In connection with the eye condition he notes: "That in shutting both eyes there is a twitching of the whole face. The brows corrugate well. The left eye cannot be shut as well

—Primary position, showing squint of 12°.

Fig. 2.—Looking to the right. Brows level.

as the right, and, curiously, the movement in shutting is just in those parts where the twitching occurs. In shutting both eyes at the same time there is no difference in the degree of closure but a greater contraction and fibrillar tremor of the whole brow, which extends to the temporal surface of the ear."

Wilbrand and Sänger's case is as follows: A man, thirty-four years of age, on recovering from severe cerebral syphilis, presented the following phenomena: In looking to the left the left palpebral fissure was strikingly wide, so that a broad band of sclerotic was visible above the upper corneal margin, simultaneously, through contraction of the frontalis muscle, the left eyebrow was drawn up. The left eyeball was incapable of going beyond the middle line in looking toward the left. In looking to the right the movements were normal and none of these phenomena were present. As there was no secondary deviation, and as the patient never had diplopia, notwithstanding the absolute loss of abduction, the condition is considered a congenital one. The authors say that in this case it is evident that the elevation of the upper lid is due not to innervation of the levator but of the frontalis. Ptosis was not present.

In some of the cases belonging to Group 3 an anatomical anomaly has been demonstrated admitting of a plausible explanation for the phenomena, but in all of the other cases it is only possible to conjecture how this anomalous association is brought about. In the case here reported the nerves supplying the muscles involved have a very close nuclear origin, and while, so far as I am aware, no connecting fibers have been demonstrated to exist normally between them, such as serves in the presence of a paralysis of one muscle to predicate an overflow to the nucleus of the other, it is not improbable that in this case such a connection exists anomalously.

DISCUSSION

DR. WALTER B. LANCASTER, Boston, Mass.: I should like to ask whether the patient made a distinct effort in abducting his eye. Was there any evidence that it required an unusual effort to make that motion, so that the effort overflowed to the frontalis?

DR. J. M. RAY, Louisville, Ky.: I should like to ask whether there were any other cases in the family with defects in the ocular muscles. I have at present two cases of congenital muscle defect in one family, in which the mother also has limited motion of the eye outward, inability to turn it beyond the middle line; yet she has binocular vision and very little tendency to squint, except when she looks in the direction of the deficient muscle.

DR. JOHN E. WEEKS, New York: I think that the third class of cases to which Dr. Zentmayer refers includes the cases of so-called retraction movements of the globe. In these cases the difficulty seems to be principally with the externus of the eye having the limited movement outward. The movement outward is ordinarily limited to the median line. On forcible adduction, there is retraction of the globe, which accounts for the narrowing of the palpebral fissure. On abduction, the globe assumes a more nearly normal position in the orbit, and the absence of retraction causes the palpebral fissure to assume its normal width without contraction of the frontalis. The cases of retraction movement are of all degrees. This condition is a congenital defect.

DR. WILLIAM ZENTMAYER, Philadelphia: In reply to Dr. Lancaster, I would say that the limitation of abduction is only that which results from secondary contracture and poor fixation in that eye. You can get him to rotate it fully as far on that side as on the other. Unfortunately, the photograph was taken without fixation, and does not show the marked contraction of the frontalis which occurs when he is made to move the eye out forcibly.

Regarding Dr. Week's case, it was among those that Dr. Duane analyzed; and I think that the explanation for the class to which his belongs is very clear, on account of the

fact that in dissection of some of these cases, a fibrous nature of the external rectus has been discovered, which admirably explained the phenomena. Here, however, where there is simply an esotropia, due to a hypermetropia, I think the trouble is probably a nuclear one.

In reply to Dr. Ray I would say that heredity was not a factor in my case.

A CASE OF SYMMETRICAL OCCLUSION OF THE PUPILS BY THE DEVELOPMENT OF CYSTS AND SMALL SOLID MASSES FROM THE UVEAL LAYER OF THE IRIS.

JOHN E. WEEKS, M.D.,
New York City.

The following case is reported because of unusual features:

Miss Nancy L. A., aged twenty-eight, was sent to me by Dr. Frank D. Skeel for treatment. Patient was feeble as a child. At the age of six and seven years was thought to be tuberculous. At the age of eleven years her eyes were examined by Dr. Sumner Hayward, of Rochester, N. Y., who discovered a formation of pigmented masses in the pupils, prognosticated blindness, and advised taking the child from school. At the age of eighteen years the patient's eyes were examined by Dr. Lucian Howe, of Buffalo, who has kindly given me the following notes of the case, made at that time:

"Ectropium of the edges of the iris in both eyes. In the right eye one spot near the inner margin measured two millimeters in diameter, and there were two other spots in that eye where the ectropium was also present. Posterior synechia was especially marked. The vision of the right eye was $\frac{6}{16}$. In the left eye two points of the ectropium were near the lower margin of the iris. V. $\frac{6}{12}$."

He advised giving up studies. Patient has suffered a great deal of pain in the eyes as long as she can remember.

She continued her studies with some interruptions, in spite of some difficulty in seeing, and has always done more or less collateral reading. At the age of twenty-one years patient suffered from nervous prostration lasting more than a year. When twenty-two years of age patient consulted Dr. Adt, of Albany, N. Y., who endeavored to produce a diminution of the masses in the pupil by means of internal medication. The vision of the eyes has gradually diminished.

Status Presens: V. R. E., $\frac{20}{60}$; L. E., perception of light. Corneæ clear. Anterior chambers about of normal depth. Irides in central third conform in some degree to the shape of the lenses, giving the impression of broad posterior synechiæ. They do not dilate on use of atropin, except at one point in the upper inner part of the right pupil, where a very small pupillary space may be obtained slightly larger than when atropin is not used.

Each pupil is occluded by small pigmented spherical masses varying in size. The right pupil presents four such masses, upper and lower large masses measuring approximately 3.5 mm. and 3 mm., and three smaller masses measuring 1 to 2 mm. in diameter. A small irregular opening in the pupillary space, not to exceed a pinhead in area, permits vision of $\frac{20}{60}$. Eyeball of normal size. Tension normal. Eyeball clear. The left pupil is occluded by several globular masses, the upper largest mass measuring about 4 mm. in diameter, the others ranging down to less than 1 mm. in diameter.

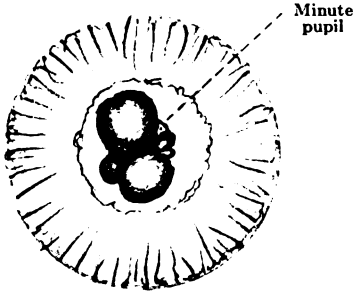
The larger masses were diaphanous to transillumination. The fundus of the eyes could not be seen, but projection was good in both eyes.

A diagnosis of the cysts of the uveal layer of the iris, with possibly broad posterior synechiæ, was made. Operation was advised and consented to. The patient was sent to the New York Eye and Ear Infirmary and the left eye operated on December 3, 1913.

An incision was made in the limbus at the upper margin of the cornea above. When the aqueous escaped the masses pressed against the cornea and were flattened. The blades

R. E.

R. E.



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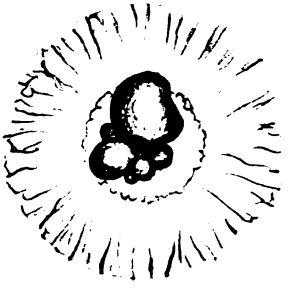

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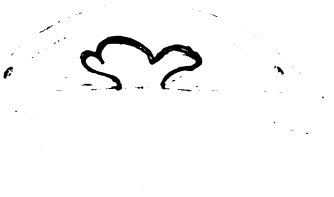

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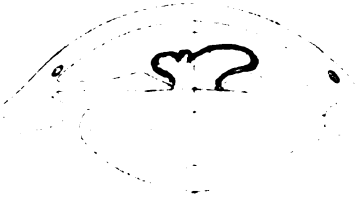

of small curved clot forceps milled on the opposing surfaces were passed into the anterior chamber and an attempt made to seize the growths and to tear them from their attachments. This was only partially successful. Capsule forceps were passed without much result. De Wecker's scissors could not be used without engaging the iris. The iris at the upper margin of the pupil was now seized so as to include the attachment of two of the masses, and a liberal iridectomy performed. The operator was surprised to find that there was no deposit of pigment left on the capsule of the lens. No evidence of synechiæ of any kind. The remnants of two of the spherical bodies were left on the lower pupillary membrane. Healing uneventful.

On December 15, 1913, the right eye was operated on. A narrow Graefe knife was entered at the limbus at the temporal side, on a plane with the plane of the iris at the pupil, and an attempt was made to sever the masses at their insertion at the margin of the pupil. This was successful with two of the larger masses at the lower margin of the pupil. The knife was then withdrawn and reinserted at the limbus at the upper margin of the cornea, and an incision about 8 mm. long was made. The iris was then seized at the pupillary margin by means of the iris forceps, the place of insertion of two of the masses included, and a fairly broad iridectomy performed. Remnants of two of the masses remained in the anterior chamber and could not be removed by irrigation. These were seized by means of fine mouse-tooth forceps and withdrawn. On removing one of these masses it was found to be still partially attached to the pigmented layer of the iris, and when it came away a portion of this layer came away with it. There was but little evidence of posterior synechiæ. Some small opaque striæ were visible in the substance of the crystalline lens. Healing progressed favorably for three days, when the eye became painful and the conjunctiva chemotic. Tension slightly below normal.

Atropin had no effect on the iris. The inflammation, which was non-infectious, continued a week. It was apparently favorably influenced by the salicylates internally. Healing then progressed favorably. There were no pigmented masses now visible in the eye. Vision, February 20, 1914, with the correcting glasses, is R. E., $\frac{20}{20}-$; L. E., $\frac{20}{20}$. Patient uses her eyes for clerical work without discomfort.

Microscopical examination: Sections of the masses that were removed were examined at the laboratory of the New York Eye and Ear Infirmary. The sections present appearances somewhat difficult of interpretation. The development of cysts in the uveal layer of the iris is very apparent. In addition there appears to have been a hypertrophy of the iris at the pupillary margin, chiefly involving the sphincter pupillæ and the tissues immediately about it. At the pupillary margin there appears to be a development of cysts by a splitting of the pigment layer, as a pigmented layer is apparent on the iris tissues as well as forming the outer wall of the cyst. Beyond the area of the sphincter pupillæ muscle the uveal layer appears to be raised from the non-pigmented layer of the iris, to have become hypertrophied, and to have formed irregular cysts, the outer walls of which consist of the entire thickness of the uveal layer. The non-pigmented wall is formed by iris tissues, the surface of which is very uneven. The iris tissue, aside from that described, presents a fairly normal appearance, except that there is apparently an increase in the number and size of the blood-vessels. On account of the non-dilatability of the iris it is inferred that either the sphincter zone is rigid or that the dilatator pupillæ muscle is defective.

The case here reported is apparently one of the development of cysts in the pigment layer of the iris, probably congenital in origin, consequent on a slowly progressive irregular hyperplasia of the cells of this layer, and to edema. A brief study of the literature is sufficient to convince the

student that cysts of the pigment layer of the iris may be classified under different heads, namely, (1) congenital; (2) traumatic, and (3) secondary to diseases of the eye.

Congenital cystic formation in the pigment layer of the iris presents some distinctive features: (*a*) It is usually bilateral. There are some exceptions to this in the cases reported. Of the cases referred to in the accompanying bibliography, 18 in number, 2 were apparently monocular—those of Graefe (1) and Businelle (2). (*b*) The development is slowly progressive, certainly up to young adult life. (*c*) Evidence of inflammation of the iris is wanting in almost all (if not quite all) of the cases.

That the formations are cystic is evidenced by the fact that they may collapse spontaneously (Worth,[17] Howe,[14]), that they collapse when operative procedure is instituted (Businelli and the author), and that the microscopical examination discloses this condition. (Author.)

Cases of this character are apparently rare. Of the authors consulted only two (Howe, Ancke) report more than one case. Those reported by Howe are the most remarkable and instructive. He raises the question of a possible relation of myopia to this condition. An analysis of the reported cases does not disclose a sufficient preponderance of myopia to warrant such a conclusion.

It is very probable that the free approximately spherical pigmented bodies that are sometimes observed in the anterior and posterior chambers (Streatfield,[6] Schneider,[7] Hartridge,[11] Coats,[18]) are derived from cystic formation in the pigment layer of the iris of the type here described. (Although disc-like pigmented masses may originate from persistent fetal pupillary membrane remains, as suggested by Coats[18]). That this is very probable is evident from the cases observed in which the spherical masses hang to the pupillary margin by a fairly broad pedicle (Howe and the author) or by a mere filament (Howe, Holmes, Businelli).

In regard to the pathology of the condition it is well known that in certain diseased conditions of the eye, as in glaucoma or in systemic conditions, as diabetes, cysts of the pigmented layer of the iris are prone to develop, due apparently to separation of the two layers of pigmented epithelial cells by the entrance of fluid from the iris tissues. The case of Collins* is apparently a remarkable example of the formation of such a cyst by pressure edema. If the fluid present in these cysts is derived from the iris it must have passed through the proximal epithelial layer. In the case here reported the entire pigmented layer, with the exception of a few scattered cells, and at the pupillary margin, appears to be lifted away from iris tissue. The iris tissue appears to be more than ordinarily vascular, and the posterior surface rough. At the pupillary margin the epithelial layers are separated. In addition it appears that the pigment layer of the iris is redundant, giving the impression of hyperplasia as well as edema.

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DISCUSSION

DR. ALLEN GREENWOOD, Boston, Mass.: About eight years ago, at a meeting of the New England Ophthalmological Society, I presented a patient whose case was very similar to the case reported here today. The case was one of bilateral cysts from the pigment layer of the iris. The patient came to me, not for the cysts, but for chronic glaucoma which had developed in both eyes. She gave the history that these cysts had been noted since childhood, and what the connection was between them and the glaucoma I cannot state. An iridectomy was performed on each eye for the glaucoma, and during this some of the cysts were removed. Dr. Verhoeff made an examination of the tissue removed and found that it consisted of structures from the pigment layer of the iris.

DR. C. F. CLARK, Columbus, Ohio: I should like to ask if Dr. Weeks has made any investigation of the appearance of free pigment masses protruding into the pupil from the posterior surface of the iris in the horse. It is a quite well known fact that there are often seen numbers of these pigment bodies. After my attention was called to this subject I went to a farm and in the stables examined some ten or twelve horses, not a single one of which was without pigment masses protruding from behind the iris. These did not seem to seriously interfere with vision, so far as I could judge, and they did not grow very large. I wonder whether they had been investigated.

DR. JOHN E. WEEKS, New York: I am very glad to have heard Dr. Greenwood speak of his case. I presented my patient before the New York Ophthalmological Society. None of the gentlemen there had seen a case anything like it, and a great deal of curiosity was expressed as to the outcome. I had the pleasure, also, of presenting the patient again after the operation.

With regard to the masses in the eye of the horse, these are very well known, and are spoken of as grape-like bodies. They differ from the masses in this case in not being cystic; they are apparently prolongations of the ciliary processes. The anterior portion of the processes advance forward on the iris of the horse. Other animals, also, have the same condition.

THE PATHOLOGY OF THE CORNEAL SECTION AND ITS COMPLICATIONS IN CATARACT EXTRACTION.

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Montreal, Canada.

Reviewing the recent advances in general surgery, as well as the operative treatment of the organs of special sense, the modern procedure of the removal of the senile cataractous lens holds a premier position. In delicacy and refinement of operative skill, as well as in the manifestation of subjective results, it is unsurpassed by operations performed upon any other human tissue or organ. That the results of cataract extraction are to be regarded as some of the most brilliant in the annals of surgical achievement is a fact not to be gainsaid. On the other hand, it cannot be denied that in a proportion of cases, fortunately comparatively small, some trifle occurring at the time of operation or shortly afterward may convert what at first promised a brilliant result into an irremediable calamity. With the object of investigating the healing process of peripheral wounds of the cornea the author has secured a collection of pathological material postmortem, as well as eyes which have been enucleated on account of the more serious complications following the extraction of the senile cataractous lens. Other features of possible interest have been brought out by experimental work on animals, illustrating the process of healing of the cornea when incised, and the effort made at repair in some of the more common complications.

The cataract operation as now performed consists in the simple extraction of the lens without an iridectomy, the

cortex and nucleus being delivered through the incised capsule. The combined method, of performing an iridectomy, would appear to be the operation of choice of the more conservative operators of the present day, avoiding as it does to a greater degree a prolapse of iris with its attendant dangers. Chandler, Stock, and Elschnig excise a section of the root of the iris, a procedure which at once avoids such dangers and still has the advantage of retaining a rounded pupil. The method of shelling out the lens complete within its capsule is a procedure which, although not primarily introduced by him, has certainly been brought into prominence by Colonel Smith of the Indian Medical Service.

The healing of the peripheral corneal wound in any of these methods is comparable to that of a simple uncomplicated incision occurring at the limbus corneæ. Valuable contributions regarding some of the features of wounds of this character are mentioned by Parsons and Greeff in their treatises on ophthalmic pathology, to which the reader is referred for some of their details.

In early perforating wounds of the cornea, with the consequent escape of the aqueous, containing as it does albuminous elements, changes occur in the blood plasma or lymph with which it is brought in contact. Coagulation of these fluids occur which results in the production of innumerable excessively delicate fibrils known as fibrin, and which by their network arrangement serve to entangle lymph corpuscles as well as erythrocytes, inducing or actually producing what is physiologically understood as clot. Such a fibrinous exudate in the cornea may be regarded not only as serving to breach the incision but further to furnish the initial elements necessary to the preliminary effort at repair. The first manifestation of healing under such a condition would seem to take place through the middle or posterior fibers of the substantia propria, which are first brought into contact with the escaping aqueous. It is

obvious that in oblique sections of the cornea, as in cataract incisions, cohesion and subsequent healing are definitely facilitated. Clark considers that this cohesion is sufficient to allow the aqueous to re-secrete in ten minutes in certain cases under favorable conditions. It is equally well known from clinical experience that where such secretion of the aqueous, or, in other words, where the reformation of the anterior chamber is inhibited, the circulation of the cornea is liable to suffer.

With the apposition of the central fibers of the substantia propria there occurs a triangular gaping of the superficial portion of the section as well as of that part directed toward the anterior chamber. The anterior portion of the wound is covered very rapidly by an overgrowth as well as by a downgrowth of the corneal epithelium (Fig. 1). Regarding the ingress of epithelial cells into the wound, Ranvier considered that their presence is first of all purely mechanical. These he considers to be normally in a state of tension, which, being released, a movement takes place in the direction of least resistance. Neese endorses this statement by the observation that mitotic figures are not present in the corneal cells about the depression at this stage of the injury; they would appear to occur later and only sparsely. This may be accounted for to some extent by direct cell division which takes place rapidly in the epithelium. This process possibly increases the tension of the cells where it occurs, and inclines to push the older cells into the wound. In about twenty-four hours mitosis may be observed in the epithelium filling the wound.

Leo Loeb has demonstrated in connection with the skin and other many-layered epithelial structures that, within a few hours at the edge of the wound and before any mitotic multiplication is visible, the cells show definite ameboid and progressive motion, actually creeping over one another, so that in this way without multiplication a one or two layered

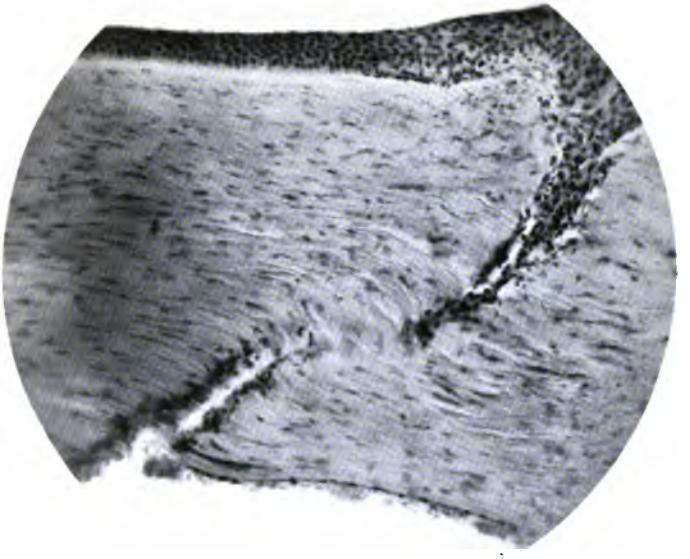

Fig. 1.—Corneal section seven days after cataract extraction. Puckering of corneal epithelium, with ingress of epithelium into anterior triangular space formed by wound. Direct healing of central corneal lamellæ. Ingress of endothelial cells into posterior triangular space with non-union of Descemet's membrane.

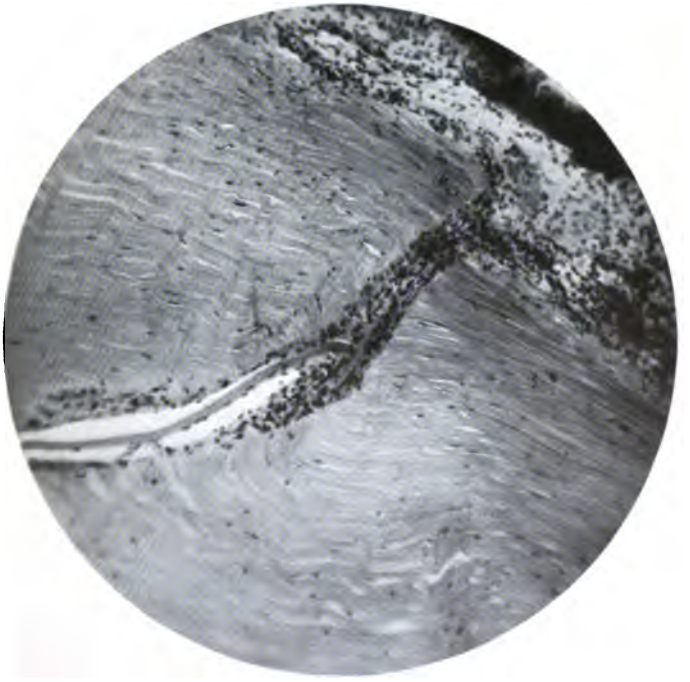

Fig. 2.—Section of cornea twelve days following operation. A very much weakened globe resulting from ingress of subconjunctival tissue cells into upper third of wound. The rest of the incision occupied by an involuted fragment of Descemet's membrane. Lower part of incision lined with endothelial cells.

epithelium encroaches over the edge of the wound. It is noteworthy that Peters, following the same idea, has described amebic movement in the cells lining a corneal incision, but his statement lacks the substantiation of other investigators. The apex of the triangular space directed forward, and to which I have already referred, may frequently extend more than halfway through the corneal parenchyma, the ingrowth of epithelium persisting for twenty-four hours, to be followed by a process of actual union.

According to Weinstein, mitosis may occur as early as one hour after operation, always in the more cuboid or cylindrical of the epithelial cells and generally at some considerable distance from the wound. In the course of a couple of hours mitosis may become more general, yet not necessarily at the lips of the incision. In four hours mitotic cells are noted in the anterior triangle as well as along each lip of the incision. At this period the process of mitosis is at its height. It is the opinion of Nüssbaum as well as of Marchand that direct cell division has not been observed.

A comparative function, though somewhat more retarded, takes place in the smaller posterior triangle directed toward the anterior chamber, where an ingrowth of endothelium may be observed. The inherent elasticity of Descemet's membrane after puncture results in its assuming a curled or spiral form and in its edges being drawn asunder. This separation of the severed ends permits an ingrowth of endothelial cells into the wound with their subsequent proliferation. This involution of endothelium, in my opinion, rather retards the healing of the wound, preventing as it does the direct apposition of the cut ends of the corneal parenchyma at this point, there being no actual scar tissue laid down here, as in the anterior triangle, on account of the absence of vascular elements (Fig. 2). I have noted sections where these endothelial cells not only cover the cut ends of Descemet's membrane and line the lips of the inner triangular space but

may be seen in considerable numbers burrowing over the cut hyaloid tissue and proliferating in considerable quantity between it and the innermost layers of the substantia propria (Fig. 3).

Weinstein has found amorphous cell masses on the convex surface of Descemet's membrane two days following a corneal section, and though no nuclei are seen in them they stain definitely with haematoxylin. Such aggregations are suggestive of an overgrowth of endothelium to which I have just referred. On the third day spindle cells are to be noticed along the posterior surface of the wound. These cells proliferate to form a band which tends to unite the cut ends of Descemet's membrane, according to Weinstein's opinion. The same author has observed shorter and larger cells with well-formed nuclei, frequently showing mitotic figures, which lie upon the spindle cells projecting into the anterior chamber. As previously suggested, all these cells are probably of endothelial origin. A combined action takes place in regard to the epithelial cells; a provisional or temporary covering of the incision by the old cells is followed by healing, the result of karyokinesis.

Regarding the healing of the cut ends of Descemet's membrane, I hold with Parsons that they never unite. By this statement I do not maintain that a regeneration of a similar tissue may not take place possibly from the endothelial cells, possibly from the innermost layer of the corneal parenchyma, which in time may fuse with Descemet's membrane. Gepner and Wagenmann offer as their opinion that a new cuticular membrane may result from the activity of the endothelial cells, which they consider may become as thick as the parent membrane and in the course of years become part of it. It is stated as possible that Descemet's membrane may split into several layers. Becker records a case in which the cut ends were united after six years. The trend of Weinstein's arguments is interesting, if proble-

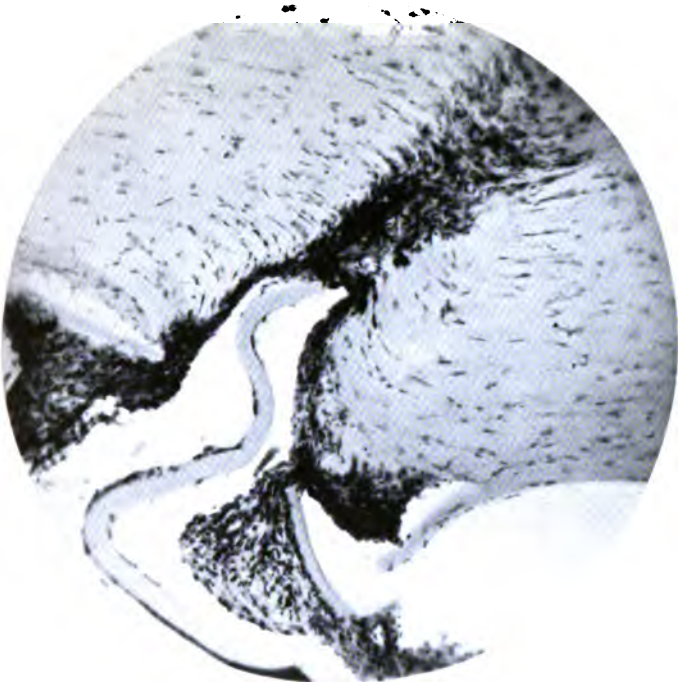

Fig. 3.—Corneal section one month after operation. Well developed healing of central corneal lamellæ. Ingress of lens capsule into posterior triangle which has prevented healing. Healing also retarded by ingress of endothelial cells. Burrowing of endothelium between Descemet's membrane and innermost fibres of corneal stroma. Fragmentation of Descemet's membrane.

Fig. 4.—Oedema of cornea following section as an early manifestation of infection. Swelling and distortion of corneal interspaces, many of which are

matical, when he considers Descemet's membrane as differentiated corneal lamellæ which have undergone hyaline changes under the influence of the aqueous. The argument may be put aside in healthy corneal tissue when we are aware of the fact that normal endothelium is impermeable to the aqueous. Although not in a position to observe a case of such long standing as that recorded by Becker, the following series of cases existing over a varying period of time support my contention that primary union of the cut ends does not and further cannot possibly occur. I have been able to demonstrate the truth of this assertion experimentally upon the cornea of the rabbit, and have shown it to be true at various periods of time in man, as the following cases attest.

Case 1.—Rabbit's cornea incised and iris drawn slightly forward into the wound. The ends of the conjunctival flap were sutured and the lids fastened together. There was no postoperative inflammatory reaction, and the eye was enucleated after forty-eight hours. Sections show the earlier stages of regeneration of the corneal epithelium bridging over the space between the lips of the corneal incision occupied by the included iris. Some of these cells have a tendency to become involuted, adhering to the edges of the cut corneal fibers and existing between them and the apposed iris tissue. In the innermost or deeper portion of the section one may also note a comparatively similar behavior on the part of the endothelial cells which extend from the anterior chamber into the wound. Between these two types of cells one notices a large segment of Descemet's membrane which, as well as the included iris, has prevented union of the severed ends of the cornea from taking place. There is also a distinct vascularization of this space, evinced by numerous red blood-cells and leukocytes, provided no doubt primarily from the cut ends of the capillaries of the anterior conjunctival vessels, and possibly to a lesser degree from the vessels of the included iris in its effort at repair. The presence of endothelium which occupies so prominent a part in the healing in this section has been brought about by

a presentation of those occupying the anterior surface of the iris or by those lining the included portion of Descemet's membrane. Histologically, they belong to the same series of cells as those lining the anterior chamber. The segment of Descemet's membrane is consequently a permanent inclusion and, covered by endothelial and epithelial cells, constitutes an integral part of the modified granulation tissue.

Case 2.—A male, aged sixty-five years, who was operated on for the relief of senile cataract. A combined extraction was performed. The operation was not attended by any difficulty, and the eye showed no subsequent manifestation of complicating conditions. During the course of a successful recovery an attack of pneumonia set in which proved fatal on the twelfth day after the cataract operation. The eye was enucleated and embedded in celloidin. Microscopic sections show a decidedly weakened globe due to two causes: First, there is an absolute absence of healing by fibrous union, this being entirely supplanted by an ingrowth of subepithelial elements. Second, the cut ends of Descemet's membrane are seen to be widely separated and contorted, very much as one would expect to find an analogous tissue as the lens capsule after the cortex has been extracted. One end of this severed membrane is seen rather shrunken, lying free from the rest of the cornea in the anterior chamber, while the other end of the segment occupies at least two-thirds of the space of the incised corneal parenchyma. An involution of endothelium, or at least a suggestion of a proliferation of these cells, seems to follow the course of the included portion of Descemet's membrane and to line the lips of the incision (Fig. 2).

Case 3.—The eye was removed postmortem one month after operation. This case has already been brought to the attention of this Society by Doctor Byers,* by whose kind permission I am able to bring the case again before your notice in one particular aspect. Microscopic sections from this case show a perfectly quiet eye with the process of healing well advanced. There is a distinct downgrowth of subconjunctival connective tissue elements and blood-vessels into the wound which form a granulation tissue

* Trans. Amer. Ophth. Soc., 1912, p. 81.

tending to establish a scar. This is completely covered by a well-formed conjunctival flap. A gaping triangle exists below, the innermost fibers of the cornea being drawn apart, while dense fibrous cells unite the central corneal lamellæ. At one or two points there is a disposition towards an inclusion of the iris into the wound, while the cut ends of Descemet's membrane, like the corneal lamellæ in apposition to it, are distinctly drawn away from one another. There is no union or indication of regeneration in Descemet's membrane in this case, the cut ends being clearly and sharply defined. One is able to note in some of the sections, a distinct proliferation of endothelium which occasionally tends to form tiny whorls at the edge of the incision. At other points these cells sometimes burrow between Descemet's membrane and the adjacent layer of the substantia propria. One is able to notice occasionally an involution of the inclusion of shreds of lens capsule which, as in the two cases previously referred to, occupies the rôle of a non-absorbable foreign body, inhibiting the process of repair of the innermost corneal fibers (Fig. 3).

Case 4.—A male, aged fifty-two. The attending surgeon, whom he had consulted for the relief of rapidly failing sight, had neglected to register the patient's light projection. Following the operation the eye became absolutely blind and for two years the patient suffered from periodic attacks of pain. The eye was finally enucleated for the relief of pain, the organ showing marked superficial and deep injection, ulceration of the cornea with an absolute tension; perception of light was absent.

Microscopic sections of the eyeball in this case revealed the presence of an enormous melanotic sarcoma occupying practically half of the vitreous cavity. There was a complete separation of the retina which, in my opinion, was partly in progress before the attempt was made to remove the cataract. There is evidence of a vertical incision through the corneal parenchyma rather farther forward than is usually the case. There has not been the slightest effort at the inclusion of conjunctival elements in the form of a flap. Union of the incision has been purely fibrous, there being no signs of granulation tissue at this late stage, it having been replaced much earlier by actual scar tissue. There is also

no indication of an included membrane within the scar. Following the operation for the removal of cataract there has doubtless been a most active iridocyclitis. This is evinced by the very dense connective tissue membrane of a postinflammatory character extending from the ciliary body of one side to the other and which is also drawn forward into the wound. One is still able to differentiate the cut ends of Descemet's membrane, separated from one another and lying free on each side of the newly formed postinflammatory tissue, where it meets the corneal section at its innermost point.

Other specimens from my work done on rabbits show not only an involution of Descemet's membrane into the wound of the cornea, with its consequent non-union, but I have been also able to demonstrate an actual fragmentation of this membrane (Fig. 3). One specimen shows particularly well after the second day, a comparatively large segment broken free from the parent membrane and existing as a distinct loop on the anterior surface of the iris as it lies adjacent to the corneal incision in a condition of prolapse.

There is consequently, in my opinion, from the post-operative cases which I have cited as well as from the observations which I have been able to carry out in animals, no doubt regarding the non-union of the cut ends of Descemet's membrane. As I have already explained, I am not maintaining that a regeneration of a similar membrane may not occur histologically identical with that of Descemet's membrane; I am not in a position to make any authoritative statement in this regard. My contention is that in sections of the cornea a direct reunion of the cut ends of Descemet's membrane does not occur, and this for several reasons. From the inherent elasticity of a completely incised membrane, as in the case of the perforated lens capsule, the cut ends are widely drawn apart. From the disposition of such an incised membrane to twist or twirl when not supported below, or even in certain cases, as I have shown, to actually break off. And lastly from the disposition of the

lining endothelium to cover over the cut ends of the membrane, inducing what might almost be considered as an inhibition to union due in certain cases to a modified form of granulation tissue minus the vascular elements—a rather unfortunate term which I am forced to adopt in such a process for want of a better one. These endothelial cells cover the cut ends of the membrane and prevent them from uniting even though these ends are not approximated.

THE PATHOLOGY OF THE CONJUNCTIVAL FLAP IN CATARACT EXTRACTION.

A short reference to the pathology of the conjunctival flap as applied to the corneal section in cataract extraction will serve to demonstrate its surgical significance and the rôle it plays in assisting corneal repair. In the first place it acts as a mechanical covering for the wound, preventing the access of air as well as of the conjunctival exudate, which is seldom free from some mild form of microbic growth. It also prevents the lips of the wound from separating and the breaking down of the incision is less likely to occur. With a section through the subconjunctival tissue a number of the minute terminal capillaries from the branches of the anterior conjunctival vessels are severed, from which an exudate of plasma is exuded and which, when fibrin is formed very shortly afterward, binds or seals the entrance of the wound completely at some remote distance from it. This action of the conjunctival flap would thus assist healing by preventing access of microörganisms through the assistance it affords in substituting direct fibrous union about the outermost corneal lamellæ as a substitute for granulation tissue. And lastly, by promoting an added determination of haemic elements in the form of leukocytes as well as of erythrocytes in order to inhibit infection as well as to promote repair (Fig. 2). Furthermore, it will be noted that, in sections of the cornea with a conjunctival flap, union of

the substantia propria is aided not so much by an ingress of superficial epithelium but rather by an ingress of the cells of the submucosa and those cells of the new connective tissue type. These connective tissue cells are frequently seen within the anterior triangle associated with new capillaries and blood-vessels, extensions from the subepithelial elements of the conjunctiva (Figs. 1 and 2). I have been able to demonstrate all these features in the conjunctival flap of a rabbit at the end of two days, at which time organized union and newly formed connective tissue were established in the flap.

The question is naturally asked why in certain cases of trephining for glaucoma a late infection occurs. One of these cases has recently been reported from Professor Dimmer's clinic by Bachstez. The bleb became infected and showed evidence of pus seven weeks following the operation. It was evacuated and staphylococcus albus was grown in culture. An excised particle of the conjunctiva from this neighborhood, after a recurrent attack, showed evidence of a subchronic form of inflammation, according to the author. Mononuclear leukocytes were present in large numbers, while polymorphonuclears were evident but to a less pronounced degree, and eosinophiles were also in evidence. New connective tissue cells could be determined by special staining. No actual bacteria could be demonstrated in the tissue by Gram staining. It is my opinion that the method of making the conjunctival flap down to its extreme corneal limitation is responsible for the infection. In dissecting the flap down to the limbus the subconjunctival connective tissue is reduced to a minimum thinness, when at the corneoscleral margin it may be regarded at times to consist of little more than the epithelial elements. It has been shown that the nidus of infection in the conjunctiva is not of necessity in the epithelial layers of cells, but often, as Morax has shown in the case of the Koch-Weeks

bacillus, to be well beneath the epithelial cells in the subconjunctival tissue. No very great degree of imagination is necessary in order to appreciate how simple it would be for certain forms of bacteria to infect the anterior chamber when the supporting cells of the filtration bleb had been very much reduced in the preliminary dissection. Furthermore, the influence of the pressure of the escaping aqueous must of necessity exert a certain degree of pressure on the cells lining the cyst with which it comes in contact, an atrophy and consequent weakening, such as one would expect to find in any inflated body, the deeper cells of the conjunctiva being reduced through pressure from a cuboid to a more flattened or squamous type of cell (Fig. 7).

Wagenmann's work dealing with the dangers of a cystoid cicatrix is of interest. He states that an eye may be affected with suppurative inflammation of the uveal tract months or years after the healing of a wound. He has recorded the results of microscopical examinations of eleven eyeballs affected in this way, and in each case micrococci were found in the interior of the eye. The suppurative process appeared in all cases to have started from the cicatrix with which the vitreous was usually found in contact. This would rather support the opinion that the vitreous is a more effective culture medium than the aqueous. Wagenmann further regarded the condition as one of new infection through the cicatrix and not one due to micrococci having entered the wound before it was healed and then for a long time remaining inert. He also did not consider it due to organisms brought to the wound by the circulation and there finding a congenial soil.

SEPTIC WOUNDS OF THE CORNEA.

Pyogenic inflammatory changes may occur in incised wounds of the cornea through the agency of the bacteria whose nidus is in the normal conjunctiva and from which,

through its rich vascular supply, disturbance in the conjunctiva is inhibited. The microörganism by far the most frequently met with in suppurative conditions of the incised cornea is the pneumococcus; other organisms of relative frequency are the staphylococcus pyogenes aureus, ezena bacillus, and the streptococcus. Microörganisms normally quiescent in the conjunctiva may acquire an added virulence through the stenosed duct, as Plaut and von Zelewski have shown. For example, the staphylococcus pyogenes albus, of itself often benign in action, may in a case of lacrimal stenosis set up a most virulent form of infection, such as is noted after the frequent transfer of this organism.

It is interesting to note Treacher Collins's figures and conclusions in regard to infected corneal incisions. From fifty cases taken in 1888 from the records of Moorfields Hospital, at a time when suppuration was a more common feature than at the present, he noted that infection in the large majority of cases was manifested on the first, second or third day following operation. In eight cases it did not appear until after the fifth day, while in one case not until after the thirteenth day.

Morton, in 1875, recorded 146 cases with 8 suppurations (5.47 per cent.). In 1883 there were 225 cases with 14 suppurations (6.2 per cent.). Marshall, in 1889 to 1893, reported 1519 cases with 26 suppurations (1.7 per cent.). Treacher Collins, in 518 operations from 1900 to 1912, had 6 suppurations (1.15 per cent.).

The lowered percentage is responsible, according to Collins, to greater precautions taken in surgical practice of the present day. Greater care is observed in eliminating all infective discharge from the lacrimal sac, conjunctiva, and the lid margins. Instruments are more perfectly sterilized, a precaution which was not adopted prior to 1883. The use of a local anesthetic has facilitated a more perfect toilet of the wound following operation. The substitution

of a corneal section with a small conjunctival flap has been an improvement on the linear section of Graefe. Further assistance has been afforded by rendering the field of operation as aseptic as possible by the use of sterile dressings.

In the cornea there may be varying grades of infection. There may be one of very mild degree, as in conditions of elagophthalmic ulceration, where slight exfoliation of the superficial cells is followed merely by swelling and overgrowth of the surrounding cells and replacement of new ones by amitosis, or budding. More definite injury is probably followed by an ingress of leukocytes and lymph from the interstitial spaces of the substantia propria, as well as from the tears which first fill the wound (Fig. 4). As the corneal corpuscles multiply they pass away bearing with them the necrotic detritus of the inflammatory process and restoring normal tissue.

In more definitely suppurative conditions there is present a period of bacterial growth with swelling, degeneration, and subsequent cell necrosis at the point of infection. There may be bacterial extension into the surrounding tissue spaces and about the more peripheral corpuscles, which become more swollen and their process more prominent. Only after several hours may evidence be elicited of the bacterial toxins having invaded the corneal lymph interspaces (Fig. 5). Following the engorgement of the pericorneal veins there is a margination of leukocytes with a consequent migration of these toward the site of the injury. As Adami has pointed out, the process is now comparable to abscess or ulcer formation.

Progressive tissue destruction, with even more marked accumulation of leukocytes, is prevented in those cases which end in healing where the blood-vessels become actually involved. This pathological truism is endorsed in the various clinical methods of maintaining or substituting

conjunctival flaps in operative procedures upon the eye, or after accidental perforation through conjunctival tissue. Adami further suggests the formation of buds or processes which later form new vessels; these he considers due to chemiotactic influence. From the marginal vein several such processes may be given off at many points and directed toward the ulcer or point of infection. If the suppurative focus be not central these are generally more apparent on the side nearest the ulcer. As these processes enlarge they become canalized and form new vessels in a previously avascular membrane which pass to the region of the injury. When once formed, these vessels may be evident for years as an indication of earlier corneal inflammatory change. When the process has not been duly arrested, the result of unequal battles between toxins and the lymphocytes, the whole thickness of the cornea becomes necrotic or septic. One has also to note in this general inflammatory stage the partial or complete exfoliation of the endothelial cells lining Descemet's membrane (Figs. 4 and 5). These, no doubt, are cast off and constitute part of the detritus recognized as hypopyon. It is true that the aqueous humor may escape through the ulcer or septic wound, but on the other hand the whole eye as an organ may be involved in a generalized inflammatory process.

PRESENTATION OF THE IRIS.

Following a penetrating wound or an extensive ulceration of the cornea the margin or stump of the iris may be irresistibly drawn forward. This course of events is a natural one following the escape of the aqueous along its newly formed channel. Such iris prolapse may occur either at the pupillary margin or at any more distant point. The membrane knuckles into the wound, although its adjacent surface would appear to have itself escaped any injury. Should the iris remain for any length of time within the lips of the

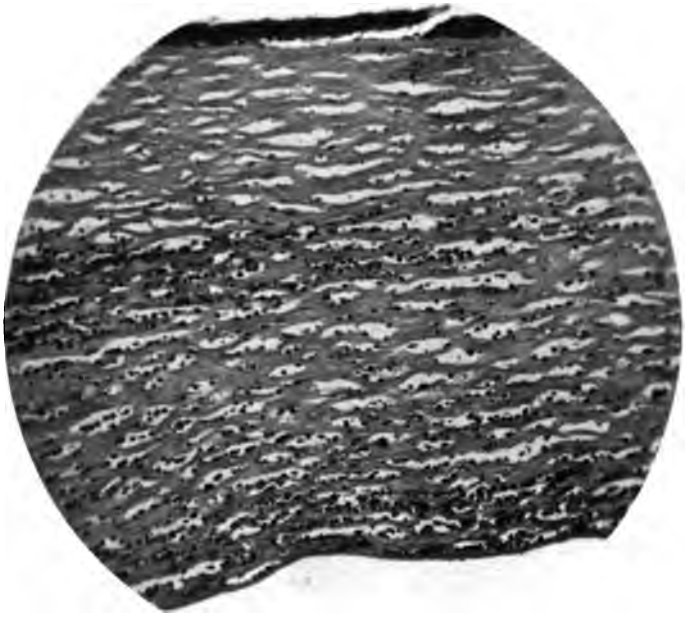

Fig. 5.—Septic wound of cornea four days after section. Infection due to S. pyogenes aureus. Distortion of corneal interspaces which are occupied by large and small mononuclear leukocytes. Comparatively smaller number of polymorphs, although these are noted to be much more numerous in anterior chamber. Exfoliation of endothelial cells lining Descemet's membrane.

Fig. 6.—Rabbit. Peripheral incised wound of cornea after forty-eight hours. Prolapse of iris into wound, with surface of presenting iris covered by

wound, a condition of anterior synechia is formed. This is constituted not so much from the presenting membrane, which in all probability forms what is technically known as leukoma adherens, but more from the resulting lymph exudate which forms between the iris and the adjacent corneal tissue. With recovery of the incision, atrophy of the included iris occurs, it being replaced by scar-tissue elements.

Changes in and about Descemet's membrane, to which I have already referred in the healing process of uncomplicated corneal wounds, play some part in this condition. An exudate of long spindle cells, with rod-shaped nuclei, replace Descemet's membrane, and, although not directly adjacent to the site of perforation, these modified endothelial cells may fill the angle between the iris and Descemet's membrane. The endothelium covering the anterior surface of the iris is liable to form a hyaline cuticular membrane upon the iris surface as a result of the irritation induced by the synechiæ. In an old adhesion, consequently, Descemet's membrane may appear to pass on to the surface of the iris, or even to split at the edge of the adhesion, one part lining the true membrane, the other the newly formed one. With the partial prolapse of iris, a grayish or brownish prominence may appear upon the corneal surface, and the anterior surface of the iris becomes fused with the edges of the wound, as in the case of the anterior synechia. Any part of the protruding iris which presents above the surface of the cornea becomes covered with lymph exudate over which the epithelial cells rapidly proliferate. After inducing prolapse of iris in rabbits, I have, after the space of two days' time, been able to show the whole presenting membrane to be covered with epithelial cells (Fig. 6). These epithelial cells are reformed not as a single layer, as one might expect, but as several layers of cells very much as one would observe in the epithelium covering the cornea. They com-

pletely bridge over the aperture occupied by the presenting iris, and extend from one lip to the other of the corneal incision. The underlying cells between them and the iris tissue proper is replaced by granulation tissue.

The contraction of the newly formed connective tissue elements has the tendency of flattening this knuckle or projection, and a firm gray scar generally results. In a certain proportion of cases this scar formation may not be sufficiently dense as to withstand the force of the intraocular pressure. The granulation tissue gives way and allows the presenting aqueous an exit, in this way constituting a cystoid cicatrix of epithelial or endothelial scar tissue and the pigment cells of the iris (Fig. 7). The bleb or scar, in such instances, may frequently appear black. Should the iris only fill the posterior portion of the wound the anterior part may heal in the ordinary way by primary union of the apposed stroma cells of the substantia propria, their union with the iris being looser than with the corneal parenchyma. Here, too, cystoid formations may occur; these, however, are not anterior to the iris but have the retinal pigment upon their posterior surface, differing from the cystoid cicatrix which is an outlying projection of the anterior chamber and covered anteriorly with uveal pigment.

In the more complete forms of iris prolapse a disintegration of the pigment of the iris occurs, the exfoliated pigment granules being taken up by the leukocytes floating free in the lymph spaces of the iris stroma. Masses of pigment cells may become permanently included in scar tissue and remain embedded for years in an unaltered condition.

One danger coincident with the prolapse of iris tissue into an incised corneal wound is the constant or transitory irritation exerted upon the ciliary body. Such stimulation or irritation of a traumatic nature may naturally be held responsible for the induction of sympathetic ophthalmia. Moreover, some authors would attribute a possible bacterial

Fig. 7.—Cystoid scar at corneo-scleral margin. Buttonhole opening in iris. Prolapse of anterior ciliary processes. Cyst lined with uveal pigment and filled with vitreous. Condition suggestive of complicated Elliot's trephine operation.

ingress to a prolapse of iris. In a former communication, however, I have shown that a highly vascular membrane, such as the iris, tends to block the wound by damming the breach with its own tissue, as well as with the lymph exudate which it throws out. By its rich vascular composition the iris is further able to carry off through its own channels of circulation invading microörganisms which might have a definite purulent effect on the incised latent and avascular cells of the substantia propria. That such an action on the part of the iris is of a suicidal nature in provoking or in actually inciting sympathetic irritation is a fact which I cannot deny. The action of this membrane, however, is in my opinion quite comparable to that of the omentum in abscess formation following perforation of a diseased appendix; a generalized septic infection would be courted were the vascular omentum not interested in the process of repair.

INCLUSION OF LENS FIBERS AND CAPSULE.

The inclusion of a quantity of lens matter as well as the presentation of the vitreous humor plays a definite rôle in the delay of primary union of the incised cornea. It is true that the cortical fibers may be included in the wound either in clumps or as isolated cells. These in the course of time are either cast off or absorbed, and ultimately granulation tissue, and later true scar tissue, follow. The period of delay necessitated by such an inclusion of foreign matter is one fraught with danger owing to the possibilities of microbic ingress. The sources of contamination in such cases are the conjunctival sac and the lacrimal passages. With regard to the lens capsule the danger may be even a more positive one. Its curled and irregular inclusion may occupy an uneven position in the incision and produce evident irritative reaction. This reaction is manifested by the lymphocytic infiltration which may proceed to the deeper

tissues of the eye, effecting a cyclitis. Such a form of inflammation, according to certain authorities, may be one absolutely due to irritation and not of necessity responsible to bacterial ingress, polymorphonuclears being comparatively diminished. Two of my sections, however, with an included membrane show a perfectly undisturbed reparative process, in one case two weeks after operation and in the second after one month. Each case had the advantage of a conjunctival flap (Figs. 2 and 3). If reaction is present it, in all likelihood, is responsible to the extreme resistance of the capsule to the process of absorption, whereby healing of the wound is delayed, and with such an inhibition satisfactory consolidation is indefinitely retarded, if not actually prevented. A more acute inflammatory reaction may be naturally induced, infection proceeding along the course of the included capsule, when a condition of generalized intraocular infection results.

Collins, in discussing the question of included lens capsule, says that in his experience pathological manifestations of inflammation are frequently limited to the parts bounding the anterior and posterior chambers, the choroid, retina and vitreous being involved. He has found in some of these cases imperfect closure posteriorly of the lips of the corneal incision due to a presentation of the lens capsule. The ununited margins of the wound on each side of the entangled capsule were occasionally infiltrated with inflammatory cellular exudate, and in some sections he thought he could trace direct continuity between inflammatory exudate in the conjunctiva overlying the wound, along the sides of the wound, to a similar condition in the interior of the eye.

He was at one time inclined to think, from the appearance of these sections, that the piece of entangled capsule acted as a foreign substance and incited inflammation in the wound around it. His present interpretation of conditions is that the entangled lens capsule does not incite inflamma-

tion but, by impeding the union of the lips of the wound, favors the spread of inflammation through the imperfect cicatrix from the conjunctiva into the interior of the eye.

In the case of the presentation and subsequent escape of the vitreous this may appear as separate particles or droplets, or it may be presented as an integral part of the whole vitreous body. Non-union in these cases is attributed to two causes. In the first place the membrana-vitrea, in being included within the lips of the corneal incision, may play very much the same rôle as the included lens capsule or Descemet's membrane. Naturally, this membrane is very much less dense than the two just referred to, and its inhibition may only be one of degree and would perhaps be in a measure comparable to the action of the endothelium lining the anterior chamber. The second reason for the possible cause of non-union is the different specific gravity of the vitreous and the other fluids as the aqueous, blood, and lymph which take part in the healing process. The vitreous, when presented, if not actually expelled through the wound, is retained within the lips very much as a foreign body on account of its more tardy resorption.

A point which I have been able to bring out in my recent comparative investigations is the assistance rendered by lymph and serum when associated with the presentation of the vitreous. From the blood which is expelled into the anterior chamber from the excised iris, or possibly from the corpuscles which have found their way in through the wound from the incised conjunctival capillaries, a fibrinous exudate is produced. These features are brought out particularly well in Mallory's phosphotungstic acid hemotoxylin, as well as in van Gieson's stains, although ordinary sections of hemotoxylin and eosin bring out these features quite distinctly. These fine delicate strands of newly formed fibrin are clearly shown in some of my sections to extend from the blood-corpuscles with which they are

evolved to the presenting vitreous, and from it to the anterior lens capsule or to the surface of the cornea or presenting iris to which the vitreous is approximated. This fibrinous exudate with the secondary influence and assistance of granulation tissue formation from the more superficial conjunctival elements does much in promoting the process of healing in such cases of presentation of vitreous.

PRESENTATION OF THE CILIARY BODY.

In occasional instances when dealing with a small hypermetropic eye, and a correspondingly large lens which contains a larger nucleus than usual, a peripheral corneal incision may be selected by the operator which encroaches into the region of the ciliary body. Such an incision really involves scleral rather than true corneal tissue. In such instances it is possible for the prolapsed anterior ciliary processes to become included or entangled within the posterior part of the lips of the incision. Such an inclusion produces not only a delay in the process of healing but actually incites very definite sympathetic dangers. Operated eyes with such a complication demand drastic treatment from the very first evidence of warning, and an enucleation is generally necessitated before an actual manifestation of the process of healing is brought about, such a manifestation being one of an acute inflammatory disturbance.

There are cases of cataract extraction where the edges of the incised wound are not brought into actual or direct apposition, or where overriding occurs. In such cases the ingrowth of the corneal epithelium may be distinctly more extensive, covering both edges of the wound and proceeding into the anterior chamber. This ingrowth of corneal epithelium may even cover the lining of the anterior chamber and the anterior surface of the iris, or may possibly line the whole of the anterior chamber. Such a process is prac-

tically a substitution of an epithelial overgrowth upon the endothelial cells in this neighborhood. The process is a rapid one. Meller states that the ingrown or implanted epithelium finds its way between the retracted ends of Descemet's membrane and the substantia propria, but that it also proliferates on its posterior or endothelial surface as well. When present these implanted cells are found to occur in strata, the innermost being cylindrical, the outermost of the squamous type. The same description applies when these cells are found covering the iris. They are often difficult to distinguish from endothelial cells normally occupying the anterior chamber lining Descemet's membrane and covering the iris.

These wounds occasionally heal in places, while delay or non-union occurs at other points occupied by implanted cells. In such instances, frequently, the evidence of repair seems quite tortuous so as to give one the appearance of a solid downgrowth of tubes or of large cystic spaces. Such incised edges, when lined with epithelium, cannot readily unite until scarification of the tract is brought about. The fistulous course which ultimately persists is then so tortuous that the aqueous is unable to escape. The walls are brought together by intraocular pressure and induce a form of secondary glaucoma, the scar, however, acting in certain favorable cases like a filtering or cystoid cicatrix.

KERATITIS STRIATA.

It is held that in certain forms of cataract extraction, when an unusually large lens has been strangulated within the lips of the wound and some difficulty experienced in its delivery, a condition termed keratitis striata occurs. This is manifested as fine grayish parallel streaks in the cornea. These striations run, as a rule, in a vertical direction, while the corneal tissue between them seems to be less disturbed. These lines or streaks may, at times, be more or less branched. It has been observed that the point of intersection of such

lines frequently results in the formation of tiny nodular opacities. Holmes Spicer describes these striations as bars or tubes which appear to be quite solid, or granular, reaching a measurement of 5 mm. In place of their being regarded as solid, they occasionally seem to have a double contour consisting of two lines with a comparatively clear space between each, distinctly suggestive of a tubular formation.

This condition in the cornea appears, as a rule, about twenty-four hours after operation, and would seem to have no derogatory influence upon the process of healing. It disappears generally between ten and twelve days. Becker and vonRücklinghausen have noticed an extension or expansion of the lymph spaces of the cornea as a possible cause for such a condition. The one point against this view is, as Lacquer has pointed out, the perfectly straight direction of the corneal opacities or striations. Newell considers the condition as being due to folds or pleats in Descemet's membrane, the endothelial cells, by such a process, being exfoliated from these pleats and the unprotected cornea rendered turbid from the influence of the aqueous. From a case examined postmortem he describes the cornea as creased or folded. On the summit of the fold there was noted an exfoliation of endothelium and a condition of non-inflammatory infiltration of the adjacent corneal cells. This he attributes to the pressure exercised by the bandage. Hess disproves this thoroughly by finding keratitis striata in eyes that have not had the pressure of a bandage applied. From experimental observation Hess considers that a widening of the corneal spaces is not present, and that the lines are due merely to a folding of Descemet's membrane following its relaxation, the result of the corneal section.

From the views which I have already outlined, one is apt to consider this condition occurring after operation as one of a mild traumatic influence originating either from irritation or from strangulation of the endothelial cells lining

Descemet's membrane. In conformity with these ideas I used to hold that, after irritation, these cells would become edematous and swollen and that they would subsequently be cast off in the same line of direction as the delivery of the lens cortex which was formerly apposed to their surface. This view also appealed to me as a possible reason for the vertical direction of these striations. After the exfoliation of these cells it seemed reasonable to follow that the underlying Descemet's membrane would be exposed to the influence of the aqueous, and that this membrane at these various underlying points would become swollen and edematous. Assuming such to be the case, these foci of edema or infiltration would, in consequence, present clinically the convoluted or tortuous characteristics which other authors have already described. The thought has also occurred that a mild degree of leukocytic or lymphocytic infiltration might be present in the innermost corneal interspaces adjacent to the lines or convolutions of Descemet's membrane.

It has further occurred to me that alterations in the endothelium might be induced or brought about by the various forms of intraocular irrigators now in use. When a direct stream is applied within the anterior chamber at an ordinary elevation of the vessel containing the normal saline solution, the remains of the lens cortex as well as the fragments of the lens capsule are removed. Healing naturally proceeds without further complication, provided, of course, no undue difficulty has been met with either in the delivery of the lens or in the performance of the iridectomy as to cause irritative disturbance. Should the vessel be elevated perceptibly in such a manner as to raise the force of the flow of the saline solution within the anterior chamber, it seemed to me probable, if not possible, that irritation to the endothelial cells might easily result. Some of these cells might be irritated by the direct contact with the force of the stream; others might be forcibly removed by an increase

in strength of the circulation brought about by the elevation of the irrigator.

Such interpretations have been dispelled by some of my recent investigations. For in several cases where I had incised the corneæ of rabbits, and where distinct trauma or irritation to the endothelial cells was purposely applied at the time of operation, no clinical evidence of this disturbance could be noticed. This was true up to four days, when the eyes were enucleated for purposes of microscopic investigation. There was, it is true, clinically a slight generalized edema around the lips of the corneal incision which one could note in any normal healing wound of the cornea, and more particularly in one in which any roughness has occurred. Examining the eyes microscopically, the sections showed, perhaps, a little additional infiltration about the lips of the wound. But in regard to the tissues which we have had under consideration, and in which we would naturally anticipate pathological changes, little or nothing abnormal could be found. The internal surface of Descemet's membrane was not denuded of its endothelial cells, Descemet's membrane itself did not appear to be swollen or edematous, and there was no apparent infiltration of lymph in the spaces between it and the cells of the substantia propria.

Following up such observations, it appears to me that we must consider such possible alterations in tissue cells from another point of view, namely, from that of age, with the changes which it brings about. For it must be remembered that in cases where striped keratitis has been noted it has appeared in those who have passed middle life. Such, at least, has been my experience. In such cases one must reasonably expect alterations in the endothelium, or in Descemet's membrane, or in both, of an atrophic or sclerotic nature. This alteration might permit access of the aqueous through these cells, possibly by a process of osmosis, when once tension has been released by a corneal section. Pathologically, the condition appeals to me as comparable in a

measure to our interpretation of the action of the aqueous through the lens capsule, where it is held by some to be responsible for the production of senile or cortical cataract.

THE ACTION OF COCAIN AND OF BICHLORID OF MERCURY.

Certain recognized forms of blurring of the parenchyma as well as the exfoliation of the corneal epithelium have been observed taking place after the use of cocain. This is true when it is instilled in the stronger solutions or when directly applied in the solid crystal or powder form. Many authorities lay the onus of the blame to the combination of cocain with mercuric salts, producing the subsequent desiccation of the superficial corneal cells. Würdinger attributes the desquamation to the fact that the eye is left exposed during the local anesthesia. He asserts that if the lids are closed during this period, and sterile water instilled during anesthesia, such desquamation is less likely to occur not only for cocain alone but also in the case of sublimate and other forms of antiseptic solutions.

Würdinger further asserts as his opinion that the parenchymatous form of inflammation, as described by Bunge, is present on opening the cornea after employing a solution of bichlorid of mercury 1:5000, but more intensely so after the prior use of cocain. Mallinger endorses this observation, but also is of the opinion that if the cornea be not opened desquamation only occurs without alteration in the substantia propria. He further asserts that the sublimate finds its way into the anterior chamber and produces through its influence there an irritation upon the endothelial cells lining Descemet's membrane. This condition is one very similar to that which Leber was able to induce after scratching the membrane. On section, one further finds the infiltrated portion of the cornea considerably thicker than the clear substantia propria, due no doubt to stagnation or to other circulatory disturbances in the lymph channels. Greeff holds that the endothelial cells are lacking

or destroyed in acute forms of inflammation and that these are restored within eight days. The clearing up of the cornea follows.

Certain forms retain the blurring in the parenchyma. Sections from these cases show that the endothelial cells have been regenerated, yet there is a wavelike alteration in the corneal cells and a serpiginous arrangement of the corneal corpuscles.

The substantia propria in these cases is in many ways rather more suggestive of scleral tissue. The cause of the disturbance would consequently appear to be the facility of ingress of sublimate through the corneal tissue by means of its deficient epithelial covering. After its secretion into the aqueous its irritating effect is produced upon the delicate endothelial cells lining Descemet's membrane.

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DISCUSSION

DR. SAMUEL THEOBALD, Baltimore, Md.: Owing to the fact that Dr. Tooke did not read his entire paper, the feature that attracted my attention especially has not been made clear. Did I understand him to say that the cut ends of the corneal section do not reunite?

DR. JOHN E. WEEKS, New York: It has been my experience, in making sections for cataract, and also in doing iridectomy with the keratome, to find the wound perfectly closed at the end of twenty-four or forty-eight hours in cases in which I have made a conjunctival flap; and, on dressing the eye at the end of forty-eight to seventy-two hours, to find filtration taking place, the anterior chamber having been restored some time before the filtration took place. I should like to ask Dr. Tooke whether he has any explanation for this. It occurs to me that the fibrillæ of fibrin become more or less dissolved within twenty-four to thirty-six hours, and owing to the strain of the intraocular tension the aqueous is permitted to escape. As a rule the healing progresses satisfactorily in the cases in which filtration has taken place, and eventually firm union results, although a cystoid scar may form. The operation in the cases referred to was smooth, without inclusion of tissue of any kind.

DR. FREDERICK TOOKE, Montreal, Canada: I think that Dr. Theobald has misinterpreted my statement. I did not mean to convey the idea that the cut ends of the cornea did not unite but rather that the ends of Descemet's membrane did not come together after section.

In regard to what Dr. Weeks has said, I am pleased to acknowledge a little information relative to my contribution with which I am quite in accord.

PSAMMOSARCOMA OF THE ORBIT IN A GIRL OF THIRTEEN. SUCCESSFUL REMOVAL WITH PRESERVATION OF THE EYEBALL AND ITS FUNCTIONS.

BY G. E. DE SCHWEINITZ, M.D.,

Philadelphia.

The history of the case which follows, as well as the results of the microscopic examination of the growth, are of sufficient interest to justify their publication.

A girl, aged thirteen, presented herself for examination in the Eye Dispensary of the Hospital of the University of Pennsylvania on February 20, 1913, in the hope of relief from a growth which occupied the upper and inner portion of the left orbit.

Family History.—The patient's father is living and in good health. He has a shortened atrophic right lower extremity, the result, he maintains, of an attack of cholera infantum when he was six years of age. Her mother died one year ago from cardiac disease following rheumatism. One sister died when she was one week old, the cause of death being unknown. There is no history of tuberculosis, neoplasm or renal disease in either the paternal or maternal line. The father denies specific taint and there are no evidences of syphilis. He has never had gonorrhea.

Social History.—The patient was born in New Jersey and is a schoolgirl. Menstruation is not yet established; she does not drink coffee; uses tea moderately, as well as pastry and sweets, and has always been "a heavy meat-eater." During the past five years she has been in constant attendance on a sick mother.

Previous Medical History.—The patient was born in normal labor and was a bottle-fed infant. She has had measles, chicken-pox and whooping cough, but otherwise

Fig. 1.—Psammosarcoma of orbit.

Fig. 4.—Psammosarcoma of orbit. Result operation.

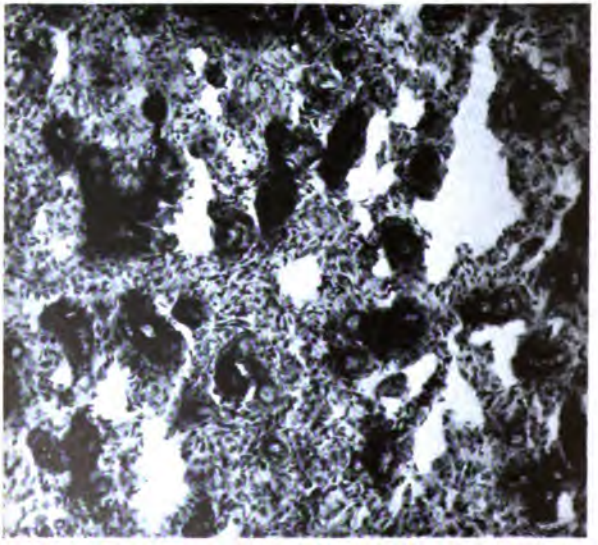

Fig. 5.—Photomicrograph of psammosarcoma of orbit.

has always been in good health. There is no history of tonsilitis, and she is not subject to colds. Occasionally she has had attacks of toothache, but her teeth are in good condition and she is under proper dental care. Six years ago she fell downstairs, striking her forehead; but this accident appears to have left no sequel, and a physician's examination at the time was negative. She has not suffered from dyspnea or palpitation or cough. Her appetite is good; bowels are regular; there has been no increase nor loss in weight; no insomnia; no night-sweats. Her mentality is far beyond the average. In point of fact, she is an unusually bright, attractive girl.

History of Present Condition.—About two and a half years ago a tumor-like mass protruding from the upper and inner part of the left orbit was noticed; there was no history of trauma except the blow on the forehead previously noted. This growth did not appear in relation to any acute illness. It has never exhibited the slightest inflammation, nor has it ever been painful. Slowly the mass increased in size, pushing the eyeball downward and outward, but this disfigurement was unassociated with diplopia or loss of vision. One year prior to her examination in the Hospital of the University of Pennsylvania she consulted the ophthalmic department of another hospital, and her father remembers that the surgeon in charge told him that there was a tumor of the orbit but that he did not consider operation wise. The records of this hospital have been carefully searched, but no account of this examination has been found.

Ocular Examination.—Right eye, vision $\frac{6}{6}$; accommodation normal; fundus entirely healthy. Left eye, vision $\frac{6}{6}$; no swelling or atrophy of the disc; in fact, no departure from normality, so far as the ophthalmoscope could discover. The rotations of the left eye were normal in all directions and there was no diplopia. The eyeball was displaced downward and slightly outward, and was 7 mm. below the level of the opposite eye. At the upper and inner portion of the orbit there was a rather dense growth, with a faintly elastic sensation on deep palpation, the surface of the mass appearing to slope downward from the orbital margin and bulge slightly forward at its inner angle (Fig. 1).

The patient was admitted to the hospital and carefully

examined in all respects. All tests gave negative results, and the ordinary rhinopharyngeal examination and accessory sinus investigation failed to determine the presence of disease in any of these regions. An *x*-ray examination by Dr. Pancoast was as follows: The skull gave evidence of the influence of increased intracranial pressure in that the markings of the convolutions were visible on the inner table. Radiograms in the anteroposterior direction showed that the greater part of the roof of the orbit was pushed upward and somewhat to the right. The frontal sinuses were obliterated on the left side as far as the midline. The anterior ethmoids were not encroached upon.

The lateral stereoscopic plates showed that the elevation of bone representing the roof of the orbit extended back as far as the level of the anterior aspect of the anterior clinoid processes. The posterior walls of the right frontal sinuses could not be seen, indicating that they were either very much thinned or that they were destroyed (Fig. 2).

It was evident from this examination that the growth was situated in the orbit, and, although it had compressed the frontal sinus in the manner already described, it did not involve it and did not appear to proceed from it or from the ethmoid. The patient was advised to submit to an exploration of the orbit, but at that time operative interference was declined. She returned again in December of the same year, with the conditions practically identical with those which have already been recorded, vision and the field of vision continuing to be normal, and with no ophthalmoscopic signs of disease in either fundus. The eye was not proptosed, and the rotations continued to be normal. Hertel's instrument failed to show any material difference in the position of the apices of the corneæ, although it is possible that there may have been about half a millimeter difference, that is to say, right 13, left 13½. All the examinations which have been previously described were repeated, and again the patient was urged to permit opera-

Fig. 2.—X-ray plate prior to operation, showing the pushing upward of the roof of the orbit and partial obliteration of the left frontal sinus.

Fig. 3.—X-ray plate after operation, showing drainage tube in position.

tive interference. Consent was given, and on January 9th I performed the following operation, with the assistance Dr. John T. Carpenter:

A curved incision was made, beginning at the center of the left eyebrow and continued through the eyebrow and along the inner side of the nose to a point exactly opposite the inner commissure. The tissues were gradually dissected downward, the eyeball being properly protected with a horn spatula, and quickly there was exposed a plate of bone, which was continuous with the brow above and the inner edge of the orbit to the nasal side, sloping downward so that when exposed it presented a surface about 2½ cm. in height and 2 cm. in width. This bony capsule was apparently complete, and therefore with a fine grooved chisel it was opened along the orbital margin and the nasal side, and the plate of bone lifted very much as a flap would be raised. It was about 4 mm. in thickness, and as soon as the chisel penetrated the cyst-like cavity, a small quantity of perfectly clear fluid escaped, which unfortunately was lost, and within the bony capsule was found a mass of tissue which in consistence and somewhat in color suggested brain tissue. This was carefully removed with a scoop and preserved for examination. The bony capsule was then removed piece by piece, and was found to be complete, all of it, however, outside of the muscle cone. A slightly ragged edge which was left along the upper and inner orbital margin was cleanly removed with rongeur forceps, and the edges smoothed with a sharp chisel. A cavity now existed between the muscle cone and the inner side of the orbit of very considerable size, estimated to be large enough to contain a small egg. There was practically no hemorrhage, and it did not seem that any of the ocular muscles had been harmed in the operation except probably the tendon of the superior oblique. The only vessel which required ligation was the supraorbital artery. The wound was closed in the ordinary way with interrupted sutures,

and a drainage tube inserted in its most dependent portion (Fig. 3).

For a few days there was a rather liberal discharge of blood-stained serum, and at each dressing through the drainage tube the cavity was flushed with a saturated boric acid solution. On the fifth or sixth day the fluid which was regurgitated after the irrigations presented a few flakes of mucopus. On the tenth day the patient went home, her house being in the neighborhood of the hospital. She returned, however, in twenty-four hours with some pain and swelling, which were found to be due to a small collection of pus within the cavity, which was evacuated, and after its evacuation healing was uncomplicated. The drainage-tube was removed, and no further complication of any kind occurred.

As may be seen from the illustration, the eye has returned almost entirely to its normal position (Fig. 4). Vision is perfectly acute, and the only postoperative complication is diplopia, quite typical of paresis of the left superior oblique. This has gradually subsided, and at the present is noticeable only if the patient looks strongly down and to the right. When the diplopia was at its maximum the double images were fused by a 6-degree prism base out, and a 25-degree prism base down, that is, there was an esophoria of 6 degrees and a left hypertropia of 25 degrees. This is now reduced to esophoria, 6°; left hyperphoria, 7°.

A specimen was sent for examination to the Laboratory of Surgical Pathology, and the sections were prepared by Dr. John Speese, who furnishes the following report:

The specimen consists of numerous fragments of tissue, a portion of thin bone and periosteum. The tissue described is soft in consistency, yellow in color, and contains minute points of hemorrhage. Microscopic examination demonstrates that the tissue is composed of a very cellular process in which are imbedded enormous numbers of refractile bodies;

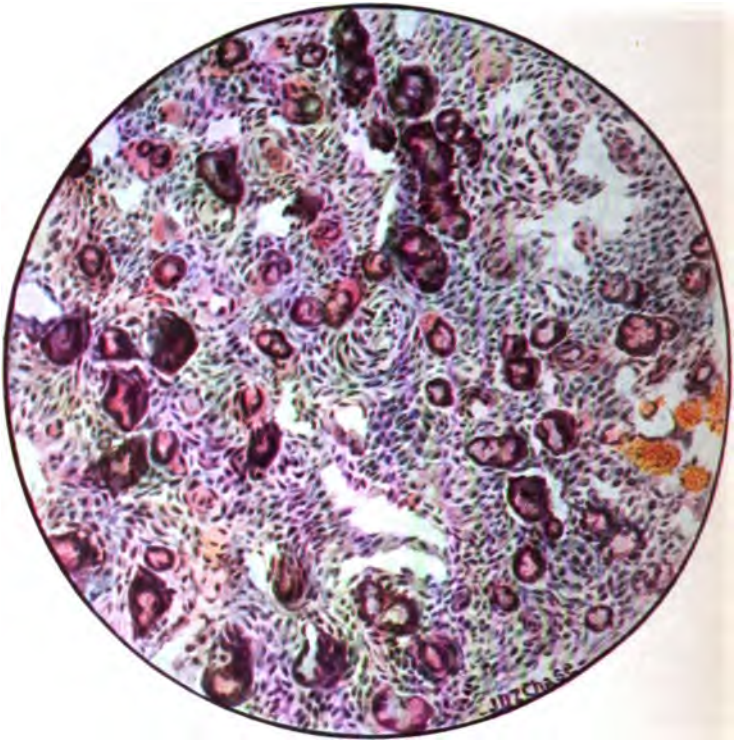

Fig. 6.—Psammosarcoma of orbit; spindle cells, "sand bodies" and free hemorrhage.

the nuclei of the cells for the most part are spindle in shape and present decided irregularities in size. Here and there the cells are drawn out to form distinct fibrils which ramify between the tumor-cells. The tissue is well vascularized, the vessel walls in many instances being surrounded by the cells of the tumor, so that a single layer of endothelium separates the vessel from the tumor-cells. Here and there throughout the tissue free hemorrhage is noted. The refractile bodies are uniformly round; their centers are pink, and the outer rims dark blue in color. These bodies are found in all portions of the tumor tissue. Unstained sections of the growth were treated with sulphuric acid. As no evolution of gas followed, the bodies were evidently not calcium carbonate in composition. They underwent solution and became represented by groups of crystals of calcium sulphate, hence they are composed mainly of calcic phosphate, or similar salts of lime, and as the cells are those seen in sarcoma, and as these sand bodies are so freely present, the diagnosis of psammosarcoma seems justified." (Figs. 5 and 6.)

Remarks.—In my previous experience I have not encountered a tumor of this character in the orbit—that is to say, encountered a sarcoma which contained sand bodies and which was enclosed completely in a thin bony capsule. I have not made any systematic search of the literature, but such a growth is not mentioned in Lagrange's "Traite des Tumeurs de l'Oeil de l'Orbite et des Annexes," nor in Parsons's "Pathology of the Eye."

Psammoma does not represent a distinct species of tumor growth, but, as we know, is the name given to tumors in which the presence of calcareous matter similar to that of brain sand has been demonstrated, and these psammomas are usually encountered in the membranes of the brain, the choroid plexus, and the pineal gland. These sand bodies may be found in tumors of various elements, and if their cells are sarcomatous, the term psammosarcoma is usually applied. According to Adami, these psammomas are

practically always of endothelial origin, and he explains their appearance as due to localized overgrowth of the capillary endothelium, at first in the main concentrically, so that the capillary becomes enlarged by the deposit of layer within layer of these endothelial cells. Thus, in the hemangio-endotheliomas of the dura mater microscopic examination will demonstrate, again, according to Adami, a collection of whorls of concentrically displaced cells, and sometimes a whorl may be found in the lumen of which red corpuscles are demonstrable. Whorls may also be noted which show hyalin changes, and frequently there is a deposition of calcareous salts in these degenerated areas. In other words, they become tumors which, when this calcareous change is marked, receive the name of psammoma.

Now it would seem possible in the present instance that the numerous calcareous bodies which are evident in the tumor I am describing have had somewhat similar origin and have developed in the capillary system of the growth by a process of degeneration and deposition of lime salts, although I have not succeeded in any of my sections in finding a whorl of this character, the center of which contains blood-corpuscles; in other words, I have not demonstrated a transition from a blood-vessel into the sand body. Although psammomas are most common in the brain and choroid plexus, they are by no means confined to this region, and I have myself seen in the laboratory of Dr. Allen J. Smith, Professor of Pathology in the University of Pennsylvania, an endothelioma of the abdomen which is crowded with sand bodies.

Exactly how the growth originated independently of the formation to which I have just made reference is not quite clear. Continuous with the supraorbital ridge and the inner margin of the orbit, and passing downward, backward and slightly forward, it was evident after removal that there was not the slightest involvement of the frontal bone,

nor, indeed, of any of the bones which compose the orbit and with which it was in close relation. It would seem that it must have sprung from the periosteum, and that the bony capsule was produced in the process of the development of the sarcoma, very much in the same way as layers of bone are produced in the so-called peripheral sarcomas of bones which are most frequently seen in the long bones. It had no connection with the muscle cone and was completely walled in by its bony capsule from the other orbital contents, which were entirely free from any pathological process. Whatever may be the ultimate outcome of this interesting case, thus far there has not been the slightest sign of recurrence, and the child is in perfect condition.

DISCUSSION

DR. ALLEN GREENWOOD, Boston, Mass.: Ten years ago there appeared at the Boston City Hospital a young woman of twenty-eight, with a marked proptosis of the left eye which was pressed outward and upward by a hard, firm tumor in the lower part of the orbit. By passing the finger nail along the lower orbital ridge, it was found that there was a sulcus there; so the growth was not a part of the ridge. An exploratory Krönlein operation was done by the late Dr. Munro, of Boston, and the case was published by him as the first case of psammosarcoma of the antrum in the literature.

The Krönlein was done, and on opening the orbital cavity a thin plate of bone was found, which proved to be the lower plate of the orbit. On opening this there could be removed a reddish, granular material filled with sand-like bodies. As soon as the patient was in a better condition he removed the entire left upper jaw, including all the sarcoma material and the sand-like bodies. The last time I heard of her, the patient was still alive. The case was published in the *Medical News*, March 4, 1905.

RADIUM THERAPY IN A CASE OF ORBITAL METASTASIS CONSEQUENT UPON AN INTRAOCULAR SARCOMA.

ROBERT SATTLER, M.D.,
Cincinnati, Ohio.

Radium therapy was advised and undertaken, despite the hopeless outlook of the present case, to test the efficiency of radioactive sources of the greatest power, or by the method of filtration and crossfire, thereby securing a supposedly more uniform penetration and equal absorption of a large orbital metastasis of a primary intraocular sarcoma.

Twenty-three months prior to his visit to me, the late Dr. W. D. Greene, of Dayton, Ohio, had promptly enucleated the patient's right eye. The pathological report described the tumor as a densely pigmented round and spindle-celled sarcoma of the choroid.

There was no positive evidence at the time of the operation, other than to assume that the intraocular growth was the starting-point or primary seat. Since then, but not until recently, countless discoverable smaller and larger nodular masses have appeared in the subcutaneous tissues of the abdomen, thorax, and lower extremities, but without physical signs or symptoms indicating the positive presence of similar ones in the more important internal organs.

The patient, aged fifty-six, though somewhat emaciated and with a worn facial expression, reiterated that his physical condition was excellent, his appetite unimpaired, that he had been able to work with his usual activity, and that, even so far as the right orbital cavity was concerned, he had suffered little or no inconvenience until he discovered several days before on removing his artificial eye, the presence of a dark rounded mass.

When first examined a dark marble-like mass about the size of a hazel-nut, its shape probably moulded by the wearing of the artificial eye, was discovered. This rounded black tumor was attached by a constricted base to a deeper mass which filled, ampulla-like, the extreme apex and adjacent regions of the orbit. It was firm to the touch, and tightly attached at the apex to the orbital walls.

Through the courtesy and kindness of Drs. Joseph and Lewis Ransohoff, who as general surgeons had been conducting numerous radio-therapeutic tests with gratifying results in cases of lymphosarcoma, carcinoma, etc., at the Jewish and Cincinnati hospitals, the radiferous tubes which they had used successfully in many instances of their own cases were placed at my disposal.

The first radio-therapeutic application was resorted to, after ablation of the rounded mass, followed by deep tunneling of the closed funnel-shaped mass, for the lodgment of the tube.

The tube remained in position for twenty-four hours, causing little discomfort. The inflammatory reaction, which was observed at the expiration of this time and during the following days, consisted of whitish or grayish-white border of its anterior or visible part, with considerable infiltration of the entire mass. Six days subsequently two tubes containing 100 mgs. were placed in similar position, the conjunctiva and lids securely protected, and this was followed by a sharper inflammatory reaction, but without pain or excessive local disturbances. The tumor area had a wider infiltrated border-line and the entire mass was visibly contracted.

At present, or months after the last insertion of the radiferous tubes, the center or crater-like opening is much contracted, but still discharges semi-solid pigment and sphacelating tissue shreds.

The many visible subcutaneous and intramuscular tumors have increased numerically and, together with countless

invisible ones, the presence of which can be assumed, although concealed in different internal organs, foreshadow a lethal termination.

The favorable influence on the orbital metastasis again upholds the therapeutic power of radium and the greater penetrating power of its rays.

DISCUSSION.

DR. SAMUEL THEOBALD, Baltimore, Md.: I might mention a case that has recently been under my observation, not the same sort of case as that of Dr. Sattler, but one in which the question of the value of radium came in. One eye had been enucleated for glioma of the retina. Some weeks later, a hard mass began to manifest itself in the orbit. I was asked to see the case and suggested that possibly the application of radium might accomplish something. Dr. Burnam, of Dr. Kelly's Sanitarium, in Baltimore, was asked to undertake the case. Two, perhaps three, applications of radium have been made, and nearly four months have elapsed since the first application. It is too soon to feel very sanguine, but when I last saw the case, about a month since, the mass in the orbit was unquestionably softer and smaller. It is, of course, possible that the indurated mass in the orbit was not really gliomatous, for in my experience it is very unusual, after enucleation of an eye for glioma, to have a recurrence in the orbit. The tubes were applied for two hours over the temporal side of the orbit and then for an hour and a quarter more over the lids. No burning of the skin followed, though some did occur after a subsequent application. I do not know the exact quantity of radium used. By means of a platinum-barium cyanide screen, the rays could be demonstrated as passing through the head and coming out behind. Whether bringing the radium tubes still closer to the brain substance would make the effect greater, it is hard to say.

DR. C. F. CLARK, Columbus, Ohio: It strikes me that it might be worth while, if we could get the radium, to have some experiments conducted as to the effect of radium on the normal eye, and incidentally, on pathological tissues. Two or three years ago, a little girl, two years of age, was

brought to me with one eye very much protruded, and, after careful study of the case, I rather concluded that I was dealing with a sarcoma of the orbit. I could not explain it otherwise. The proptosis continued and increased rapidly. I tried a variety of methods without effect. Later, concluding that something must be done, because the condition was exceedingly painful, with the consent of the child's mother that the eye should be removed and the orbit eviscerated if we found it necessary, I obtained from Dr. J. F. Baldwin a radium tube, to use with the supposed sarcoma. I made a free canthotomy and a free division of the external rectus, turned the eye inward toward the nose, and, by means of a speculum arrangement, exposed to a certain extent the field in the apex of the orbit, and I could then see a mass that resembled an angioma. I happened to have with me quite an accomplished pathologist, a Swiss surgeon, who examined it carefully and agreed with me in the diagnosis. I was in despair of being able to do anything short of evisceration, but decided to insert the radium tube and see what result we might obtain. I do not know what the exact strength was, but it was a very small tube. I projected it well down into the mass without cutting it, and left it in position for four hours, and then removed it. At the end of two weeks, I reinserted the radium tube, and left it in for the same length of time as before. At the end of a few weeks there was a marked recession of the eye, and in the course of a few months the eye had receded almost to normal position, having been when first seen level with the ridge of the nose, or beyond. I have had the case under observation for nearly two years and it is still doing well.

I do not intend to draw positive conclusions from this case. The amount of traumatism produced by the procedure might have caused some recession, but to all appearances the retraction was due to the use of the radium. I am quite well aware of the fact that we are shy of the use of radium, on account of the number of premature assertions that were made with regard to it, but I think that it is worth studying in such cases. What I arose to speak of especially, however, was this: About six months after the above treatment had been applied, on the return of the child for observation I found that the eye which before the use of the radium had been clear, had developed a well-marked nuclear cataract.

There had been, however, some atrophy of the optic nerve on the first inspection, and the eye was apparently blind before I used the radium at all—evidently as a result of the disease. The development of the nuclear cataract was of no great consequence in this case, because the eye was practically blind before, but it was very significant to me, and I think it might be well for us to learn something by experimentation as to what applications of radium will do to the eye,—especially in the situation where I used it, back near the ophthalmic ganglion. I drew the inference though perhaps future experience may not warrant the conclusion that, as I had inserted the tube back of the eyeball, the influence on the nutrition of the lens was more marked than it would have been if the radium had been applied externally.

DR. ANDREW TIMBERMAN, Columbus, Ohio: In March, 1910, a blacksmith, fifty-four years of age, with failing vision, consulted me. The vision was $\frac{20}{40}$, or a little better. On dilating the pupils a cone-like mass, having its attachment near the ciliary region, was plainly made out. I thought it could be nothing but a melanosarcoma from its shape and appearance, and gave it as my opinion that the man's only hope would be to have it removed. There was no redness, no increased tension, and no pain. Fortunately for him, as I thought at the time, he consented, and enucleation was done. A specimen was subjected to microscopic examination and found to be a melanosarcoma. There was no transmigration of cells into the sheath of the optic nerve, and no involvement of the orbital structures. Two years later he returned and there was no recurrence.

Three years passed and I saw nothing of him. A few months ago, I was in his neighborhood, and asked about him; and I was told that he had died of a cancer of the abdominal region. Of course, I have been wondering whether there might have been some connection between the two growths, or whether the last was something entirely different from the first. I simply mention the case as shedding a little light on the prognosis in these cases.

DR. HARRY FRIEDENWALD, Baltimore: I only want to say a word about a case, in order to point out a possible bad effect of radium. The patient, a woman of seventy, came

to me in February of last year for a very large basal-cell epithelioma of the upper lid, involving the entire lid and extending back into the orbit. It was of such size that nothing short of entire removal of the upper lid was possible, or so it seemed. The case was submitted to Dr. Kelly, of Baltimore, for his opinion regarding the use of radium treatment. He approved of it, and ordered several massive applications. As the result, the growth disappeared entirely within a few months, and there was apparently perfect recovery. The eyeball, in the meantime, was healthy. The vision was good. The patient left Baltimore in June for the South (she lived near New Orleans), apparently in good health, with only slight irritation of the eye. A few weeks ago I received a letter telling me that the eye became much inflamed and had to be enucleated, on account of glaucoma, by Dr. Matas. Whether the use of radium had anything to do with the development of this glaucomatous condition I do not know; but it is worth mentioning it. I may add that there has been no recurrence of the growth.

DR. E. C. ELLETT, Memphis, Tenn: I have seen a patient with an epithelioma over the region of the lacrimal sac who was treated in Baltimore, under Dr. Kelly's direction, with radium, and a very excellent result obtained, so far as the cure of his epithelioma was concerned. He had previously been treated with the *x*-ray without effect. He has had since that time a little conjunctivitis as the result of his lacrimal obstruction, but no affection of the eyeball.

DR. WILLIAM ZENTMAYER, Philadelphia: I should like to speak of the possibility also of aggravating cases by the use of radium. The history of the case I have in mind is too lengthy for me to give and I shall not go into it, except to say that it was an epithelioma of the lower lid, which had formerly been treated by Dr. Sweet by means of the *x*-ray, with no decided benefit. Later, the case was treated with radium; and the growth made very rapid progress thereafter. It spread from the lower to the upper lid, and involved the eyeball, necessitating evisceration of the orbit. There is no question that the growth was stimulated by the application of radium.

DR. ROBERT SATTLER, Cincinnati, Ohio: It was with no little trepidation that the radiferous tubes were resorted to in the case briefly reported. To do this most effectually, the larger projecting mass was removed with the snare and, this accomplished, the tubes were pushed into the apex of the orbit and secured by means of thin leaden discs to prevent unnecessary burn of the tissues. Neither burn or violent reaction followed the two applications which lasted twenty-four hours.

TUBERCULOSIS OF THE BULBAR CONJUNCTIVA.

GEORGE F. LIBBY, M.D.,

Denver, Colorado.

Tuberculosis of the eye is not rare, but when its description is illustrated by a good picture in colors it seems worthy of being placed on record. The use of tuberculin in ocular lesions is a well-established therapeutic measure, but the employment of the direct rays of the sun as a curative measure in tuberculosis of the eye is a more novel method of treatment.

On June 17, 1912, an unmarried woman of forty years was referred to me for conjunctival inflammation, in the service of Dr. Saling Simon, at Mercy Hospital, Denver. Two months before, the cervical glands on the right side had become enlarged, and presented a rather deforming mass in the neck. A month later the inner half of the bulbar conjunctiva of the right eye became red during sleep. On inspection four small, pale, firm, whitish-red nodules were found in the conjunctiva, covering the attachment of the internal rectus; a larger one behind and above these, and also a large, firm, deep-red nodule under the somewhat infiltrated plica semilunaris and pushing it forward. Examination of smears and scrapings from the nodules, by Drs. Simon and Burdick, did not reveal the tubercle bacilli or other microörganism. The apex of the right lung was

slightly infiltrated; otherwise there was no apparent pulmonary involvement. An *x*-ray examination of the chest was not made. The temperature was subnormal in the morning, normal in the evening, while at the hospital.

The local treatment at this time consisted only in cleansing with boric acid solution and the application of heat when the eye felt uncomfortable, which was rarely. The unsightly appearance was all that the patient seemed to mind, as to the eye. Tuberculin was administered hypodermically every five days. Reaction in the affected eye was noted after the first injection, and subsequently when the dose was increased. Rest in bed, liberal diet and abundant fresh air were enjoined. On July 30 two pale, flat-round, yellowish nodules appeared on the conjunctiva below the others and toward the plica. The older nodules were slowly subsiding at that time.

When the patient entered the Montcalm Sanatorium, Manitou, August 6, 1912, there had been slight general improvement. On August 11 Dr. Gerald B. Webb, of Colorado Springs, began the use of tuberculin, with ¼ cc. of $\frac{1}{5000}$ mgm., T. R., which was gradually raised so that 1 cc. was reached by December 9. Sun baths were ordered for the enlarged glands on August 11; and on August 21 daily exposures of ten seconds were begun for the conjunctival nodules.* On August 28 the conjunctiva was exposed to the direct rays of the sun for sixty-three seconds. This was then ordered to be repeated from two to six times a day. On September 3 the conjunctival inflammation was much better. On September 9 the exposures were increased to three minutes and twenty seconds. The conjunctiva became intensely inflamed on September 30, and the pseudo-diphtheria bacilli were found in the discharge. The sunlight treatment was omitted for two weeks; then resumed for one week, beginning with an exposure of ten seconds, and finally was discontinued, as it seemed to cause slight irritation. It is believed that the patient exceeded instructions as to length of exposures. The first infection subsided in a week. It rekindled on October 21, but again yielded in one week, the

*See Rollier and Bord, *Rev. Méd. Suisse romande*, April 20, 1912; abstracted in *British Med. Jour.*, Epitome of Current Medical Literature, July 20, 1912, page 11.

tuberculin not being interrupted either time. By November 4 the weight had increased five pounds, and the glands were improved. From this time the conjunctival nodules gradually subsided, and six months later complete cure had occurred, except slight infiltration in and beneath the plica. The patient continued to gain in weight slowly. It should be stated that the preauricular glands were never affected.

On December 16, 1912, $\frac{1}{20}$ cc. of $\frac{1}{2500}$ mgm., T. R., was given. This had been increased to $\frac{13}{20}$ cc. by July 9, 1913, when the patient went to Durango, Col., for eight weeks. Here she lost twelve pounds in weight, the cervical glands became more enlarged, and the eye "flared up" and was somewhat painful in the last week of her absence. On her return Dr. Webb resumed the tuberculin, beginning with $\frac{6}{20}$ cc. of $\frac{1}{2500}$ mgm., T. R., $\frac{14}{20}$ cc. being reached by December 30. Soon after this the patient resumed her work as a teacher. The glands in the neck had diminished in size, the eye was free from inflammation or its effects, and the general physical condition was much improved.

Although the tubercle bacilli were not recovered from smears and scrapings of the nodules, yet their appearance, the affection of the cervical glands and apex of the lung and other physical signs, together with the results from treatment, all indicate a tuberculous conjunctivitis. As the cervical glands became involved two months before the ocular lesion appeared, the latter would seem to have originated in the former and to be secondary rather than primary tuberculosis of the conjunctiva. Whether the glands were infected from an early-stage involvement of the right lung or through that common port of entry, the tonsil, or from some other source, must remain an open question.

Indebtedness to Dr. Webb is acknowledged for notes on this interesting case after the patient left Denver. In May, 1913, the writer again personally examined the eye with great care at Manitou.

To Dr. William C. Bane is due sincere thanks for the very excellent watercolor drawing illustrating the involvement of the bulbar conjunctiva, which was made on July 10, 1912.

Tuberculosis of the bulbar conjunctiva.

REPORT OF A CASE OF TUBERCULOSIS OF THE SCLERA OF PROBABLE PRIMARY ORIGIN.

GEORGE HUSTON BELL, M.D.,

New York City.

The great achievement of Robert Koch has supplied us with means by which we can learn through a specific reaction if active or latent tuberculosis is present in the human body. Tuberculosis of the sclera will always be of interest to the ophthalmologist, whether primary or secondary, on account of the rarity of the disease, and as Verhoeff[1] has pointed out it is a commonly unrecognized form of tuberculosis. The case which I wish to report has some unusual features, and I thought it might be of interest to the Society.

Miss A., white, aged twenty, was referred to me June 1, 1913, by Dr. H. D. Long, of New York, for the treatment of the left eye. Patient gave an indefinite history of having injured the eye, as she thought, while dressing her hair. She consulted her family physician, Dr. Long. He prescribed some yellow oxid ointment. After this the inflammation did not subside, but she continued under his care and treatment for one month before she consulted me. The eye gradually grew more painful and the inflamed zone so increased, and was complicated by the development of hard, reddish nodules in the sclera, that he thought it best to consult an oculist. Tuberculin had already cleared up the diagnosis for him. On examination I found two or three definite nodules in the sclera, on the temporal side, about 3 mm. from the limbus. The injected conjunctiva could not be moved over it. The nodules then appeared dark red or violet in color. Another and larger dose of tuberculin was given to further confirm the diagnosis. At this time .00004 gm. of tuberculin bacillen emulsion ("B.E.")

produced the following reaction: marked infiltration and erythema at the site of the injection, and marked constitutional symptoms. Her temperature rose to 101°, and she complained of great headache. The focal reaction in the eye was most pronounced, with increased chemosis and congestion of the conjunctiva and sclera. The eye was excruciatingly painful, but unattended by any secretion save excessive lacrimation. At this time there was no iritis, cyclitis or keratitis. I advised weak solution of atropin and hot applications in addition to the tuberculin. V. O. D., $\frac{20}{15}$, with correction; O. S., $\frac{20}{30}$, with correction.

On June 5 I saw her again after she had had another dose of tuberculin. The eye was somewhat more injected. The conjunctiva could not be pinched up from the solid mass which remained in close apposition with the subjacent sclerotic. I found we had here to deal with a diffuse deep scleritis. The treatment was continued.

On June 10 the inflammation in the sclera seemed to be extending, and the nodules were more painful. The tuberculin injections were kept up by Dr. Long. I did not see the patient again until June 20, at which time the swelling had increased. The mass was extending both toward the periphery and the limbus, and the inflammation had extended to the cornea and uveal tract. The nodules were dull reddish in appearance. The veins were thickened and the blood darkened, giving the veins a paralyzed look. The pupil was contracted. The strength of the atropin was increased, and the hot applications continued in addition to the tuberculin injections.

On July 1 I next saw her, when she was more comfortable. Up to this time she had had twelve injections of tuberculin. The process did not seem so angry. There was less congestion and the nodules were not so swollen, but there was an infiltration of the cornea at several spots. I did not see the patient again until July 16, at which time the first drawing was made by Dr. Percy Fridenberg. (Fig. 1.) In a letter to me he described what he saw as follows:

"On the temporal side of the cornea about at the horizontal meridian there is a decided crescentic opacity near the limbus, and at the limbus a small, flat, smooth nodule of chamois-leather or pinkish-buff color. Continuous with

Fig. 1.—Tuberculosis of sclera. Condition July 16, 1913.

Fig. 2.—Tuberculosis of sclera. Condition October 29, 1913.

this, and spreading through the sclera to the outer canthus, there is an area of inflammatory thickening and injection. General color, dull pink or old rose, not uniform; and near the upper margin of the area, which is broadly ribbon-shaped, there runs an enlarged vein of dark rose color. The scleral infiltration is soft in appearance, almost jelly-like. The corneal nodules more consistent. There is a very little general conjunctival injection."

I did not see patient again for about one month. She went away to the country, but kept up the injections of tuberculin and eye treatment.

On August 16 the thickening of the cornea was softer looking and more grayish, and the congestion of the diseased sclera not so pronounced. The dose of tuberculin was rapidly but cautiously increased. Patient was now getting .0001 gm. of tuberculin every four days.

On September 1 the patient's eye was not so well. There was increased capillary pressure and venous engorgement, and, locally, circulatory disturbances which led to increased transudation and swelling of the nodules. The cornea became involved by interstitial infiltration, which was localized in the form of round plaques near the margin of the limbus. The treatment was continued.

On September 15 I next saw the patient. The condition seemed to be slowly subsiding, but there was still slight iridocyclitis, due to the inflammatory process having extended from the sclera to the ciliary body.

On September 24 the patient was given .02 gm. of B.E., and on September 28, she was given .04 gm. On October 2 she was given .06 gm., and on October 6 the dose was cut down to .01 gm. on account of general reaction. The injections were continued every four days.

On October 19 the patient showed the encroachment of scar on outer border of the cornea and a further encroachment below on temporal side. There was a decided injection of sclera over the affected area, purplish in color, and marked injection of vessel leading to outer canthus. She was given .028 gm., with severe general reaction, marked reaction of lesion and marked infiltration and erythema at the site of injection. The injections were discontinued.

On October 29 the eye was much better. The infiltration

in the sclera was absorbing, leaving behind a slate-colored cicatrix. The pupil was dilated and the eye was not sore or painful. This peculiar slate-colored pigmentation not only points to the diagnosis but gives the etiology as well. Dr. Fridenberg made his second drawing. (Fig. 2.) You can see the patch of scleral discoloration, also the remains of the dilated and tortuous vein.

On November 7 the patient was given .00002 gm. and the dose was gradually increased again until she had her last injection on December 5, which was .0004 gm., when the eye had apparently recovered and was perfectly quiet, and the treatment was discontinued. The eye has remained quiet up to the present time, February 15, 1914. Her vision now is O. D., $\frac{20}{15}$, with +.50 cyl., axis 105°; O.S., $\frac{20}{15}$, with −.50 sph. ⊂+1.50 cyl., axis 90°.

Except for the scars on the cornea and the pigmentation of the sclera, you would not know that anything had ever happened to this eye.

Prior to sending her to me Dr. Long had made a thorough physical examination of her lungs, which was negative. Patient well nourished and healthy. Also there was no enlarged or diseased tonsils and no bacilli could be found in the sputum. Family history good. We did not subject this patient to the Wassermann as we did not think it was necessary. Verhoeff[1] claims that these nodules in scleritis, with the reaction, are conclusive evidence of the tuberculous nature of the process. The question naturally arises: How was the sclera infected? Was it primary? Some ophthalmologists claim that deep scleritis is always secondary. Parsons[2] is in doubt on the subject. A close observer like Weeks[3] calls attention to two cases of apparent primary tuberculosis of the sclera. One of the cases reported by Brailey[4] was of a young girl who was treated at Guy's Hospital. The other was Müller's[5] case, which was a cyst of the sclerotic, the walls of which were composed of miliary tubercles. Gœrdeler,[6] in his exhaustive article on rare forms of tuber-

culosis, reports six cases of primary intestinal tuberculosis, one primary of the uterus, one primary of the liver, and three primary cases of the urogenitals, no other lesion being discovered at necropsy.

We all know that it is possible to have a primary tuberculosis of the conjunctiva following an injury. The history of traumatism, followed by prolonged inflammation and infiltration, together with the absence of any signs of systemic involvement, leads me to believe that the sclera was inoculated by the lodgement of dry bacilli in the form of dust on the conjunctiva, through which the germs passed at the time of the injury. Notwithstanding all our advanced methods of examination and points in differential diagnosis, we cannot state as an absolute fact that any case of tuberculosis of the sclera is primary, but the preponderance of evidence in this case indicates that it was primary. It is interesting to note that this patient had 50 injections of tuberculin. The last dose was on December 5, at which time .0004 gm. was given. Fifty injections seems like a small amount to give a patient when we stop to consider that White,[7] of London, has taken over 500 doses himself, extending over a period of seven years, for general tuberculosis. White has now watched many patients who have taken tuberculin steadily for periods varying from two to five years—cases of tuberculosis of the eye, of bones, of glands, of the skin, and of the throat, and the improvement in many of the cases was due to tuberculin and to tuberculin mainly.

Fenwick[8] speaks of two ways of giving tuberculin, one by hypodermic injection and the other way by the mouth. The former is obviously the more scientific, and the latter has been generally condemned as of no value. Nevertheless, it is a method that Fenwick has employed as a routine in the out-patient department, and he speaks of it in the highest terms.

In concluding, I will say that, from the experience I have

had in treating scleritis, sclerosing keratitis, and anterior uveitis with tuberculin, I have found that it is not necessary to increase the dose of tuberculin to the farthest limit of tolerance. I believe strongly in small doses to begin with, gradually increased and continued over a long period of time. I have never seen any harm result from its use. Well-diluted tuberculin treatment constitutes a real and great therapeutic progress.

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DISCUSSION OF PAPERS OF DRS. LIBBY AND BELL

DR. JOHN E. WEEKS, New York: I should like to ask whether Dr. Libby thinks that the exposure to sunlight had anything to do with the recovery of the patient. Those who treat numbers of cases with tuberculin find that recovery takes place without the use of anything else, aside from keeping the general system in good condition.

DR. GEORGE F. LIBBY, Denver, Col.: Answering Dr. Weeks, I would say that the inspiration for the use of direct sunlight in this case was the well-marked instance of a medical student in Switzerland, whose eye was infected with tubercle bacilli in opening an abscess, which spurted into the eye. In that case, the nodules were on the palpebral conjunctiva, rather than the ocular. Direct sunlight, without the use of tuberculin, brought about a cure. I know that my case is open to the criticism that it would have recovered any way under tuberculin, without the aid of insolation; yet I feel that it was a good stimulant up to the point when it was discontinued. Then it had become too stimulating and was discontinued for that reason. I think that it was helpful, though not curative.

DR. WALTER L. PYLE, Philadelphia: I desire to report the case of a woman of forty years who came under my care with inflammation of both anterior ocular segments, believed to be tuberculous in nature. She had received repeated injections of tuberculin, with apparent cure, followed by recurrence. I instituted rigorous local treatment with no apparent relief. It seemed to me that the case was hopeless; and in desperation, I made an injection of diphtheria-antitoxin. Immediately afterwards the eye began to improve. I discontinued all anti-tubercular treatment, and used ordinary local measures for inflammation of the anterior ocular segment, and, although I did not get very much improvement in vision, the eyeballs became quiescent. They are still quiet, eighteen months afterwards. The improvement undoubtedly began immediately after the injection of diphtheria-antitoxin. When I first saw her she was just able to walk, from weakness, worry and pain. After the antitoxin, there was noticeable physical improvement and evidence of strong metabolic stimulation.

DR. A. EDWARD DAVIS, New York: Though I have not had a case of undoubted primary tuberculosis of the sclera, I am pleased to add to the discussion of Dr. Bell's interesting case by citing a remarkable case of this disease reported by the late Dr. Herman Knapp, in a Jubilee Volume dedicated to Professor V. Helmholtz on his 70th birthday, by the Heidelberg Ophthalmological Society.

In this contribution Knapp reports one undoubted case of primary tuberculosis of the conjunctiva; also one case of conjunctival tuberculosis spreading in the well-known manner from lupus nodules in the nose through the lacrimal canal to the conjunctiva.

The case of primary tuberculosis of the conjunctiva was the result of accidental infection following a subconjunctival squint operation. The patient was a slender, pale girl, nineteen years of age, but in good health, upon whom, in the fall of 1889, Dr. Knapp did an advancement operation of the external rectus and a subconjunctival tenotomy of the internal rectus of the right eye, as a combined operation for marked convergent squint. The wound at the site of the advanced muscle healed in the usual way and the stitches

were removed on the fifth day; but the wound in the conjunctiva just below the tendon of the internal rectus had a grayish-white coating, and took four weeks to heal. Six weeks after the tenotomy, "the reddened inner half of the conjunctiva was covered with a group of glassy nodules the size of millet seeds." This condition was taken for trachoma and was treated accordingly for several weeks without improvement; in fact, the nodules increased in number and size and one appeared in the upper retro-tarsal fold, and at the same time the pre-auricular gland became greatly swollen. Tuberculosis was suspected; some of the nodules were removed as well as the pre-auricular gland. Microscopically tubercle bacilli were found in the nodules, but none in the scrapings from the gland.

The patient was placed on tonic treatment, codliver oil, nutritious diet, while the local treatment consisted of incision of the nodules, the use of the galvano-cautery, and the application of a 1–5000 solution of bichloride of mercury, six or eight times a day to the scleral conjunctiva. A year later the eye remained completely cured. May 17, 1891.

Rabbit's eyes inoculated with the material from the nodules became tuberculous and underwent caseation. Pieces of iris taken from these inoculated rabbit eyes when stained and examined microscopically, showed tubercle bacilli. Further, a second rabbit's eyes inoculated from the first one became tuberculous and underwent caseation. Without any possible doubt, therefore, the human eye from which the rabbits were inoculated must have been affected with tuberculosis.

As regards the manner of infection in his case, and as to the permanency of cure, I cite Knapp's own words:

"The fact that inoculation in our case was quite accidental needs no proof. The bacilli could not have adhered to the sterilized instruments, but must have got into the conjunctival sac from the air, and from there been carried into the subconjunctival wound by the squint hook. Examples are known of tubercular infection of other wounds. Tillmanns says "It is important for the surgeon to know that tuberculosis of the skin and of the lymphatic glands has been observed particularly after scratches, skin eruptions, and ulcers. Czerny in two cases saw tubercular inoculation after skin transplantation."

Notwithstanding the complete recovery of the patient described in Case II, I am not very sanguine as to the permanent cure of the conjunctival tuberculosis. We must remember how long a local tubercular process may lie dormant, and it seems to me doubtful whether conjunctival tuberculosis as well as lupus of the skin and mucous membranes is ever permanently cured. There is a possibility of it certainly. That the process may remain local and need not necessarily poison the organism is shown by numerous observations as well as by the cases in which an inoculation tuberculosis has remained local. The eye was destroyed, but the animal lived, and when killed years afterward, tubercles were nowhere to be found. The tuberculosis in each eye of the rabbit in our first case, inoculated from an iris tuberculosis in man, healed not only without spreading of the veins, but with preservation of the organ primarily affected.

DR. SAMUEL THEOBALD, Baltimore, Md.: May I ask Dr. Libby and Dr. Bell whether the tubercle bacillus was found in the cases, or whether an effort was made to recover it from the ocular areas of inflammation. The focal reaction, of course, was very significant; but the recovery of the bacillus from the diseased tissues would more definitely clinch the diagnosis.

DR. LIBBY: In answer to Dr. Theobald, I may state that we did not get the bacilli from the scrapings. I should also like to add one other word. You have all doubtless noticed that in Switzerland, of late, good results have been obtained in the treatment of bone and visceral tuberculosis by direct rays of the sun; and the inspiration for their use in my case was the success met with in Switzerland. It seems to me that in high altitudes at least, where the sun's rays are so abundant and this treatment is ready to hand, insolation constitutes a rational therapeutic procedure.

DR. GEORGE H. BELL, New York: My case was in a private patient. When we got the local reaction, and also the constitutional, I did not think it well to subject her to the microscopic tests. We could not very well do it, as she was a lady and a private patient.

A CASE OF ALTERNATING TRANSIENT MONOCULAR BLINDNESS ENDING IN COMPLETE LOSS OF VISION IN THE LEFT EYE.

H. MAXWELL LANGDON, M.D.,

Philadelphia.

The case to be reported is that of J. P. T., aged forty, white, married, and by occupation a traveling salesman. He first consulted me in September, 1905, complaining of severe and frequent headaches, at least one a week, and lasting about twenty-four hours. They were general in character, not connected with use of the eyes, nor had he any accompanying ocular symptoms. He had been refracted several times, and felt that the correction worn at that time, which he had had for five years, gave him clear vision, but that a change might benefit the headaches. He also said that at times he lost his sight and at other times saw double. On further questioning I found that he had attacks of monocular blindness, lasting from three seconds to five or six minutes, the eyes being about equally affected. If there was any difference he thought the left might be more frequently affected. He had been blind in both eyes simultaneously but once, the attack lasting about two minutes. As to the diplopia, it was transient and fleeting, occurring about once a day, one object being above and to the right of the other. This lasted usually about thirty seconds. The first thing he would notice in one of the blind attacks was often a diplopia; the vision would then gradually become hazy until it was entirely gone; then a hole would appear in the fog, as he expressed it, and vision would gradually return. His central vision seemed to always return before the field would clear in the periphery. He had never had attacks of hemianopsia, scotoma scintillans, nor did a headache accompany the blind spells. His general health had always been excellent except for occasional attacks of muscular

rheumatism in the shoulders and lumbar muscles. The attacks of blindness had occurred since early childhood.

On examination his eyes showed no external anomalies, the pupils and extraocular muscles being normal and the conjunctivæ and corneas clear. Central vision was O.D., $\frac{6}{12}$, cc. $\frac{6}{6}$, O.S., $\frac{6}{15}$, cc. $\frac{6}{9}$. The muscle balance at six meters showed orthophoria in both the vertical and horizontal meridians; at 33 cm. there was four degrees of exophoria, with orthophoria in the vertical. Ophthalmoscopically the media were clear, the discs oval with clear margins and normal in color, with small central excavations. The retinal vessels were normal, the arteries showing no signs of sclerosis. The rest of the fundi were equally negative. There was no diplopia with a red glass, and the visual fields were normal. Under a cycloplegic he took: O. D. +1.25 sph. ⌒ +1.50 cyl. ax. 95° = $\frac{6}{5}$; O. S. +1.00 sph. ⌒ +2.00 cyl. ax. 85° = $\frac{6}{5}$; this was ordered, less + 0.50 sph. for constant wear. At my request he had a general physical examination made by his family physician which was absolutely negative, as far as urine, heart and lungs were concerned. His blood-pressure was 140. His glasses seemed comfortable to him, the headaches seeming less frequent, though they still continued, and he was dismissed with the request that if it ever were possible to communicate with the writer or get to him during an attack he would do so.

Nothing further was heard from him until January 24, of the present year, when he reported that an attack in the left eye had begun about 8 o'clock the previous evening, and had not cleared up, the eye still being blind.

Examination showed V. O. D. = $\frac{6}{5}$, O. S., faint light perception. The pupil of O. D. was 3 mm., reacting normally; that of O. S. was 5 mm., not reacting to direct light but responding well consensually and to accommodation. The ocular motions were full and equal in all directions.

Ophthalmoscopically the media were clear in each eye. The right disc was normal in color and outline, the arteries were of good size but with a slight increase in the reflex, some irregularity in caliber and slight indentations of underlying veins; the fundus was otherwise negative. The left eye had a disc which showed almost a complete loss of capillarity; the retinal arteries were in places mere threads,

with here and there a small amount of blood remaining; the veins were very much reduced in size, and the temporal portion of the retina was edematous with a dark spot at the macula. There were no hemorrhages or other changes.

He was placed on nitroglycerin and inhalations of amyl nitrite, but without effect. His physician, Dr. L. A. Ward, wrote me concerning him at that time: "His heart has been very rapid but I have not been able to detect a murmur. I have felt it was due to Bright's, but have repeatedly examined the urine, finding nothing wrong with it. He has been quite asthmatic, having to sit up part of the time to sleep. This seems entirely cardiac, as I can detect nothing wrong with the bronchi or lungs. His blood-pressure is 195 degrees, systolic."

Since then he had a complete cardiac collapse with failure of compensation, which developed an aortic regurgitant murmur, edema of the legs to the groin, and great cardiac dilatation. Fortunately, he has made a very excellent recovery; the heart is again nearly normal in size, the edema has completely disappeared, and except for the blindness of his right eye he is in fairly good condition.

Whether the loss of vision was due to an attack of vascular collapse in which the circulation failed of restoration, or whether it was from an embolus whipped from the diseased aortic valve, is possibly open to question. It would more likely be the former from the history, for the attack differed in its incipient stage in no way from the hundreds which had preceded it. The sensation of a fog hovering before him, with the gradual veiling of vision, was exactly what he was familiar with from former experiences, and he expected nothing but a gradual return to normal conditions. This return did not take place, in all probability owing to the thrombus formation in the closed artery with its intima roughened and sclerosed.

Transient loss of vision, other than that due to an increase in intraocular tension or acting as the ocular accompaniment of an attack of migraine, has been reported by many writers both in this country and abroad, several authors having had the opportunity of studying eyes while undergoing an attack from which there was complete recovery.

Mauthner, Noyes, Benson, Sachs, Wagenmann, Harms, Weiss, and Harbridge, whose patient was also studied during attacks by Zentmayer and de Schweinitz, have all had such good fortune. The account of the phenomena by each differs in detail, but in general terms is described as more or less complete ischemia of the retina depending on whether all or only some of the branches of the artery were involved. The return of circulation is variously described as a "wave" or as "an advancing column," and synchronous with its appearance or immediately afterward vision returned, so there can be no doubt that the cause of the visual loss is failure of retinal blood-supply, and as additional evidence of this may be offered those cases where there has supervened permanent disaster after a series of transient attacks, where the picture is always one of a circulatory block.

Permanent blindness of an eye not preceded by transient attacks of visual loss in the organ affected nor accompanied by such an attack in the fellow eye is invariably ascribed to embolus or thrombus, but it seems difficult to conceive of such cause where the attacks are followed by entirely normal conditions both as to function and appearance, and often after so many years. Some other reason for the failure of circulation must be offered to satisfactorily explain such conditions.

Leber, quoted by Priestley Smith, believed that these transient attacks of blindness were due to sudden diminution of the amount of blood in the retinal arteries from a slowing of the current. He thinks the sharp bend the vessel makes in passing from nerve trunk to retina, the absence of collateral circulation, and the resistance offered by the arteries, all tend to make the retinal artery very liable to such an accident.

Nettleship found valvular heart disease in both the cases studied and reported by him. He believed that the ex-

planation for the arrest of the blood-stream to the retina, which he felt was the undoubted cause of the blindness, was the fact that the central artery of the retina was a small terminal twig of the ophthalmic, and the latter was given off from the internal carotid at a right or even an obtuse angle, and that anything which tended to narrow the lumen of the retinal artery could easily shut off the weak stream.

Von Graefe saw a bilateral case where he believed the circulatory failure was caused by the difference in intra-ocular tension and the pressure of blood in the vessels. He performed a bilateral iridectomy with complete restoration of sight.

Mauthner proposed doing an iridectomy in his case, but, before he could prepare his instruments and operate, vision returned.

Loring* reports two cases in connection with other forms of circulatory disturbance, and states his belief that the vessels become empty from lessened heart action.

Werner in an article on Vascular and Other Retinal Changes in General Disease† says: "Another theory of causation which formerly met with very general acceptance in cases of the kind is that of spasm of the central artery or of its branches. In view of the pathological findings, however, there is no longer any necessity to assume the presence of spasm, and pathologists seem averse to accept this explanation. There is no doubt of the possibility of the occurrence of spasm, but it is difficult to prove its existence apart from experiment. The evidence in its favor so far as the retinal arteries are concerned is based partly on the ophthalmoscopical appearances observed during the attacks and partly on analogy.

"The phenomena observed during the course of the re-establishment of the circulation in the vessels when the

**Amer. Jour. Med. Sci.*, 1874
†Ophthalmol. Soc. U. K., 1913.

attack is passing off can, in most cases, be explained on mechanical principles as easily as on the assumption of arterial spasm; but the appearance of a constriction traveling like a peristaltic wave toward the periphery of the fundus is difficult to account for except in this way. In the opinion of some (Reimar, for instance) these descriptions of the ophthalmoscopic appearances are really due to a wrong interpretation of the phenomenon known as visible streaming, produced by the agglutination of the corpuscular elements of the blood in a stagnant current. The argument from analogy is drawn from cases accompanied by symptoms of Raynaud's disease and from cases of migraine. But in neither of these classes of cases has it been proved that spasm actually occurs, although it seems to afford a natural and simple explanation of these diseases. Raynaud's supposed detection of spasm in the retinal vessels in some of his cases was not corroborated by Panas, who also examined them. Besides, in the majority of the cases of Raynaud's disease, it appears that the vessels are diseased."

Werner accounts for the emptying of the retinal arteries by a drop in blood-pressure lessening the vis à tergo which is no longer able to force the blood through the narrow lumen of the diseased artery, he assuming that the arteries of all with such attacks are sclerosed. He thinks the length of time the blood-pressure is below its former level determines whether the attack will be transient or permanent.

Of the reporters of cases who have had opportunities of examining their patients during attacks, the majority seem to think the condition is one of spasm of the vessels—Wagenmann, Benson, Harbridge, and Zentmayer, who saw Harbridge's case; de Schweinitz, who studied the same case during an attack, said in discussing it: "The exact pathological condition is to a certain extent a matter of conjecture but certainly it would seem that the phenomena are best explained by assuming the presence of a spasmodic contrac-

tion of the walls of the artery"; and he quoted observations of Schnabel and Sachs in partial real obstruction of an artery as proving that here the spasmodic contraction of the walls of the artery was a factor in interrupting circulation.

Werner feels that those who depend on analogous conditions to support their claim that arterial spasm empties the vessels rather than that they passively collapse, being deprived of their contents by failure of the blood-stream, are calling to their aid a weak argument; but is Werner fair in his description and consideration of the analogous

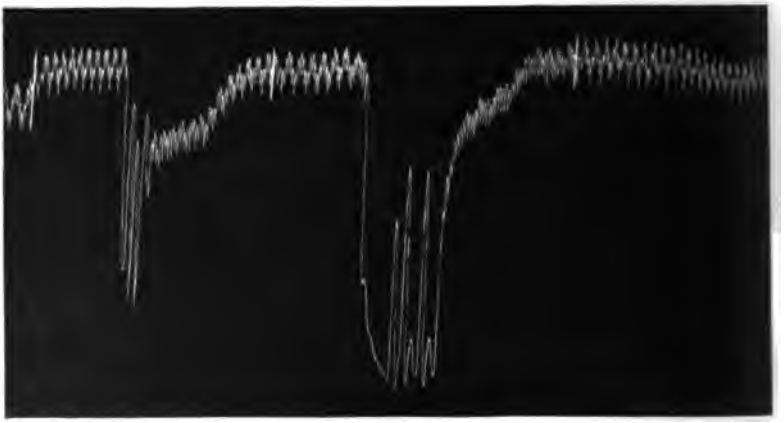

Fig. 1.—Fall in pressure due to vagus stimulation.

conditions? He says the vessels are usually sclerosed in Raynaud's disease, and seems to think this is averse to the production of spasm. Oppenheim thinks that here the condition is most probably produced by spasm, endarteritis being present in some cases. When one recalls the clinical changes in parts affected in Raynaud's disease during a paroxysm, the pallor, the shriveled glossy skin, the absence of bleeding on trauma, the paresthesia, the severe pain, all finally either disappearing without other signs or being followed by cyanosis and possibly gangrene, surely spasm

rather than passively empty vessels seems the more likely cause, and if there be spasm here why not in the retina?

Let us consider that unusual symptom-complex known as intermittent claudication or limping, first recognized in horses and later studied by Charcot in man. The attack appearing suddenly with pain and fatigue in one leg without objective signs, after a little rest the trouble clearing up. Charcot showed that it occurred in subjects whose iliac and crural arteries are the site of sclerosing and obliterating arteritis, and believed that possibly a failure of nutrition of

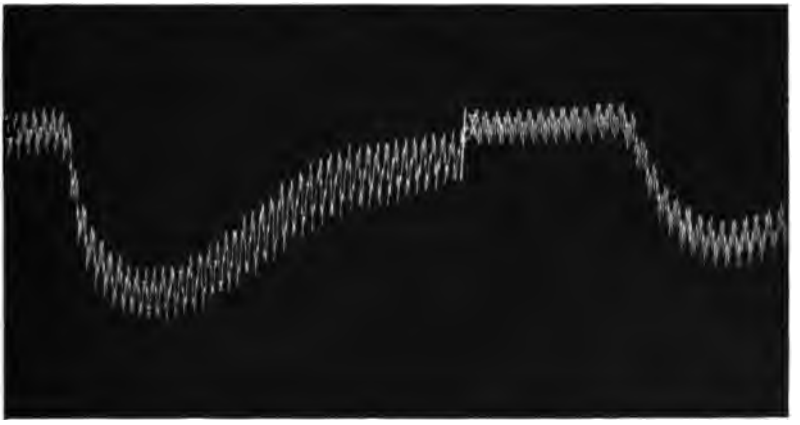

Fig. 2.—Fall in pressure due to inhalation of amyl nitrite.

the muscles took place, and felt, as does Oppenheim, that the attack is probably produced by spasm of the vessels. If spasm takes place here why not in the retina?

At last, but far from least either as evidence or in importance, is that peculiar condition for which so frequently advice and relief are sought in the office of the ophthalmologist, migraine. To enumerate the more common symptoms here is needless, but there are certain manifestations which suggest a course of events in some cases similar to that of these cases of transient blindness from circulatory interruption:

first, the cases where there have been many attacks of migraine with functional derangement, hemianesthesia and aphasia especially, which culminated in an attack which did not clear up but became permanent, closely paralleling the periods of visual loss in the writer's patient, and the final permanent defect; second, the cases where a typical organic lesion of some portion of the brain has been simulated many times—for example, one of Oppenheim's where a typical cerebellar symptom-complex was produced; third, those cases of transient blindness associated with migraine and transient diplopia in the same subject, as in the case just

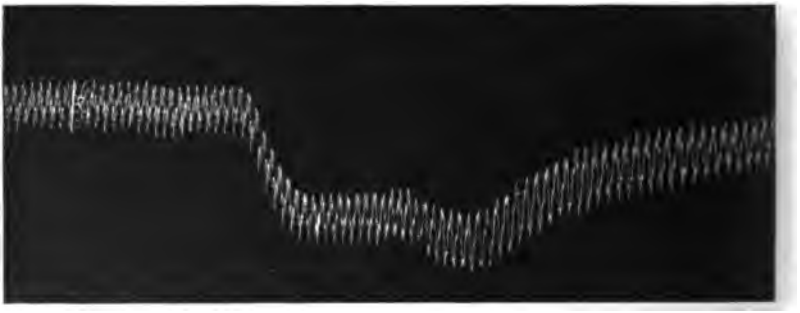

Fig. 3.—Fall in pressure due to injection 3 minims of 1% nitroglycerine.

reported, making it seem possible that contraction of different vessels occurs at different times.

As additional evidence, pointing toward spasm rather than a drop in blood-pressure as the etiological factor in these cases, may be considered the therapeutic results in one of Noyes's patients: a man blind in both eyes for sixteen hours with typical fundus changes, and who completely recovered in twenty minutes following inhalations of amyl nitrite, a drug which promptly relaxes capillaries and lowers blood-pressure.

Let us now consider briefly the explanation advanced by Nettleship and Leber and in a modified form by Loring and

Werner. Nettleship and Leber each believed that the abrupt diminution in size of the blood-stream from the internal carotid to the ophthalmic, as well as the abrupt turn made in changing its course, had a decided retarding effect on the flow, and a narrowed lumen of the central artery might be sufficient to block the stream enough to empty the vessels; then a change in relations would again occur, and the blood with pressure behind and little or none in front would surge forward and again fill the vessels.

Loring and Werner seem to think that anything which produces a sudden fall in blood-pressure will tend to empty the retinal arteries, and a return to normal pressure will

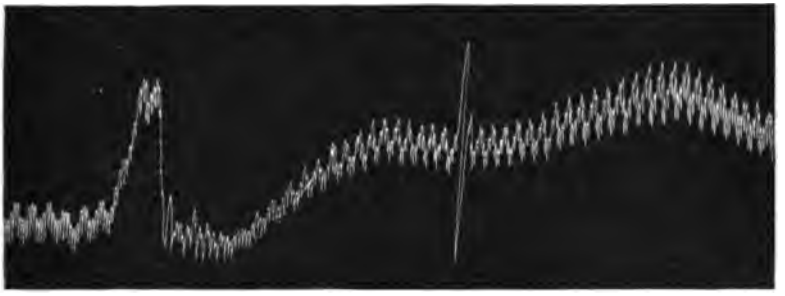

Fig. 4.—Increase of pressure due to 1 cc. of 1–1000 adrenalin chloride.

once more fill them, the duration of the attack being decided by the duration of the drop of arterial pressure. But changes in blood-pressure sufficient to produce such a profound circulatory change would surely produce more general symptoms and would not be confined to one or both of the retinal arteries alone. The writer recently had the opportunity of studying a patient whom he had seen some months previously with a blood-pressure of 230 and very decided fundus alteration, edematous discs and blurred margins, advanced arteriosclerosis, and many superficial splashes of retinal hemorrhage. In the interval the man had passed through an attack of paratyphoid fever. On recovery his

blood-pressure was but 160, accompanied by weakness, vertigo and great cerebral discomfort. The edema of the disc was completely gone, the margins were quite clear, the retinal hemorrhages were absorbed, and nothing but the sclerosed vessels were left of the previous picture, but he was much more uncomfortable than before, and not until the blood-pressure gradually reached its former high point did he cease to complain. If a gradual change produces the great discomfort observed in this case, how much more would a sudden sharp drop disturb the general economy. And yet many of these patients pass through dozens of

Fig. 5.—Fall in pressure due to removal of 300 cc. of blood.

attacks with no general symptoms worthy of comment. In none of the three cases reported by Posey, nor in the writer's case, were there any general symptoms during an attack. Blindness came and went, and, except for the visual loss, they suffered absolutely no discomfort. For a drop in blood-pressure of such magnitude, and it would seem of necessity to be a drop equal to many millimeters of mercury, to so limit this effect seems almost incomprehensible and to border on the impossible. What is needed is a blood-pressure reading of a patient during an attack, and the writer doubts if there will be much departure from the mean average of that patient, indeed a slight increase would not be sur-

prising. As in many other conditions which have undetermined causes it may be that more than one explanation is the true one, and that both spasm and pressure alteration play a part.

If we study the reports of the cases we find that they divide themselves rather loosely, and yet with fairly clear demarcation, into two groups, the one and by far the larger, in which the first attack occurred about or after middle life, where on the first examination signs of general cardiac, vascular and renal involvement were found. Here the attacks possibly may be caused by a slight drop in blood-pressure, with a retinal artery of much lessened lumen. But there remain several cases, one of Loring's beginning at twenty years of age; Dewey's case, cited by Posey, where the attacks began at eight years of age and culminated in complete visual loss in one eye at thirty-nine; Priestley Smith's case of a woman, aged twenty-four, in whom ovariotomy stopped the attacks; his case of a woman, aged twenty-five, where both eyes were completely blind during an attack with no fundus changes at the intervals; and a third case, that of a woman, aged eighteen, who had transient losses of only the lower half of the right visual field, with no fundus changes during the intervals; and the early life of the writer's case, for even up to eight years ago there were no ophthalmoscopic nor clinical signs of arterial degeneration. Possibly Benson's case may be grouped with these, for his attacks began when he was twenty-eight, and there was but slight arteriosclerosis; later he developed a toxic amblyopia. Surely in these cases it would seem some explanation other than blood-pressure alteration is required.

The writer believes that possibly the course of events may be somewhat as follows: some congenital anomaly in the vasomotor mechanism (none of these cases have been related so far as known, but a tendency to migraine is most certainly a familial condition) and some process producing

spasm through the ill-arranged nervous control, either reflexly, as in Priestley Smith's case cured by ovariotomy, or by direct toxic action, as in Benson's case which later developed tobacco amblyopia. Indeed, in the other group the toxic agent which produced the sclerosed arteries may in the early course of events have set them in spasm.

Through the kind assistance of Dr. C. H. Plant and Dr. W. G. Wood, of the Department of Pharmacodynamics of the University of Pennsylvania, the writer was able to make a series of experiments on the effect of sudden alteration of blood-pressure on the retinal blood-vessels of a dog. The animal was a young male, weighing ten kilos, and the work was done under ether anesthesia. The right femoral artery was opened and a canula attached to a mercury manometer was inserted. The stimuli used to produce the pressure changes were, first, electrical stimulation of first one and later simultaneous stimulation of both pneumogastric nerves, producing a drop in blood-pressure, first of 45 per cent., and in the second instance of 50 per cent., without appreciable effect on the retinal vessels; second, inhalations through the tracheal tube of the contents of an amyl nitrite pearl, with a drop in pressure of 50 per cent., repeated in five minutes, followed by a drop of 25 per cent., with very slight pulsation of the retinal vessels but no other appreciable changes; third, introduction of three minims of a 1 per cent. solution of nitroglycerin into the left femoral vein, with a drop of 33 per cent. in pressure, but no changes in retinal circulation; fourth, 1 cc. of 1:1000 solution of adrenalin chlorid injected into the peripheral end of the left carotid artery, with abrupt rise of 25 per cent. in pressure, but no changes in the retinal vessels, the left eye being under observation; fifth, 300 cc. of blood withdrawn from the left femoral artery, with gradual fall in blood-pressure of 60 per cent., but without noticeable changes in the retinal vessels. The writer's observations with the ophthalmoscope

were confirmed by those of both Dr. Plant and Dr. Wood.

It seems to all three quite impossible that the changes in general blood-pressure produced could fail to have caused symptoms of collapse in a conscious animal, and it also seemed unlikely that, in an individual with normal arteries, a drop in blood-pressure alone could empty the retinal vessels without the production of other symptoms.

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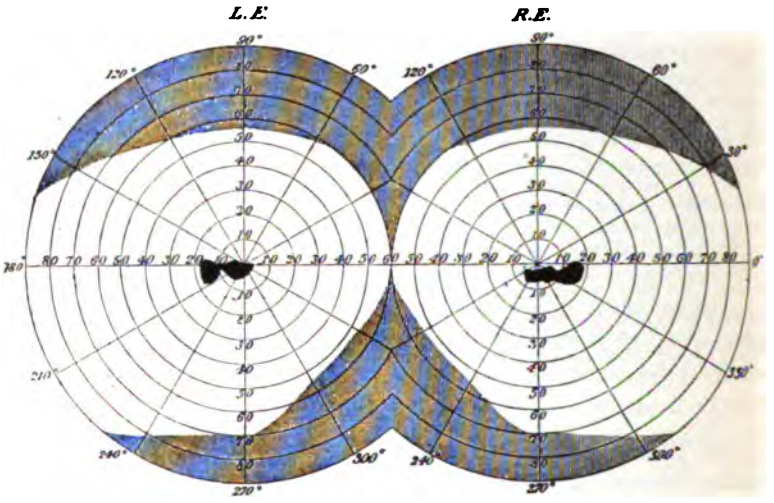
DISCUSSION.

DR. ALEXANDER DUANE, New York: I had the opportunity of seeing a case of recurrent blindness of this sort, which affected the two eyes at intervals of a couple of years; and the second time, I saw the patient during the attack. When she first came to me, she had some history that led me to test her for a central scotoma; and I assured myself that she had no central or paracentral scotoma. Three years ago she came in saying that the day before and the day before that, she had had transitory obscurations in sight in the right eye. I found her vision in that eye $\frac{18}{50}$— and discovered an absolute paracentral scotoma, bordering the point of fixation and connected with the blind spot. I found the interior, to all appearances, absolutely normal. I used inhalations of nitrite of amyl and deep massage of the eyeball, and the vision came up progressively. Within the following day or two, it was normal; although the scotoma remained, and has remained to this day, in that eye.

Two years later, she came in saying that she had just had an attack, which had started a few hours before in the other eye. The vision in that eye was less than $\frac{18}{200}$, and there was a general haze over the temporal region. With the ophthalmoscope, I saw, passing from the disc, a cilio-retinal artery, going out to the macular region. For a small portion of its extent, on the disc and beyond the disc, this artery was absolutely occluded and thread-like. I tried massage, and sent for nitrite of amyl. The vision and ap-



Absolute scotoma in both eyes.

pearance remained the same until I gave an inhalation of nitrite of amyl. I examined the patient while she was taking it, and I saw the vessel actually dilate under my eyes until it filled to a normal size. The vision from less than $\frac{18}{200}$ returned to practically normal. No test was made of the blood-pressure, except by feeling the pulse with the finger and with this there seemed to be no change, the pulse being normal in fulness and tension. The eye was soft. Since then, she has retained a paracentral scotoma, quite symmetrical in both eyes. They are shown in this diagram, the left one being the scotoma in the left eye, and the right one that in the right eye. It seems to me that if there ever

was a case of spasm, this was one, with the sudden diminution of sight, the sudden collapse of the vessel, its sudden filling again under nitrite of amyl, and the restoration of vision except for the scotoma in each eye.

DR. T. B. HOLLOWAY, Philadelphia: It has been my privilege through good fortune as well as courtesy to see several of these very interesting cases. If Dr. de Schweinitz does not object, I will refer to one that I had the pleasure of seeing at his office, the history of which was reported five or six years ago before this Society. This patient had complete obliteration of the arterial tree, but under massage and pilocarpin all the branches refilled except two vertical ones. In a patient with obstruction of the central artery, whose history was reported at the same time, temporary obstruction of vision had extended over a number of years, and in one instance persisted for a half hour. In another similar case there was a preservation of the field about the blind spot, and this observation has recently been confirmed by other cases put on record by Coats. Recently a patient was referred to the University Eye Dispensary, from the service of Drs. Stengel and Pepper, and when first seen showed complete obliteration of the blood stream in the superior nasal artery for a short distance beyond the disc, and beyond this a few blood cylinders were noted. While under observation this vessel was seen to slowly refill, and despite repeated and prolonged subsequent examinations, no recurrence of the phenomena was noted. This patient had temporary obscuration of vision which persisted for several minutes. Examination of his field made immediately after the refilling of the arterial branch failed to show any sector defect, but did show an apparent concentric contraction which I believe was functional.

In reference to Dr. Langdon's observations, I can say that, in conjunction with Dr. O. H. P. Pepper, we started some laboratory experiments on dogs, but owing to the temporary interruption of this work in Philadelphia, only one dog was used, so that I mention the result with some hesitation. At first a canula was inserted in one carotid and attempts were made to study the intraocular effects of interruption of the blood stream in this artery. Later, a

five per cent. solution of peptone was injected which produced a condition analogous to anaphylactic shock. In this one instance no effect was noted in the vessels until the pressure was reduced to about thirty-five, when there was decided blanching of the disc. The greatest care was taken to avoid the slightest pressure on the eye. This seems to be in accord with Dr. Langdon's observation. The obliteration of the vessels in these cases does not seem to be dependent upon the reduction in the general blood-pressure. In reference to the visible streaming referred to by Dr. Langdon, I had the pleasure some time ago of watching a most unusual case of this character, doubtless due to a specific endarteritis of the superior temporal artery. There was present the usual fog-bank, due to edema, or as Elschnig and others have suggested, necrosis of the retina. Beyond this bank the formed elements of the blood could be seen coursing towards the periphery in the main branch, while in another branch there was a reversal of the blood stream. Subsequently there developed the unusual condition where the formed elements coursed peripherally in the proximal portion of the vessel and centrally in the distal portion, the streams uniting to pass upward in a small vertical branch. In other words the blood stream was flowing in two directions in the same branch. This phenomenon was watched for several days, over periods of two hours at a time.

DR. JOHN E. WEEKS, New York: I should like to call attention to one or two points. One is the possible differentiation between the phenomenon of loss of vision accompanying cases of migraine and that accompanying spasm of the blood-vessels; also the cases of transient embolism and thrombus. In cases of spasm, the transient loss of vision is not followed by cephalalgia, so far as I have been able to determine. In migraine, cephalalgia follows the scintillating scotoma in almost all cases; there are some exceptions to the rule. A short time ago I was called on the telephone by a gentleman who said that he had been riding horseback and had suddenly lost the vision of his left eye. He came to the office about three hours after noticing this loss of vision, and said that his vision was beginning to return. On examination, there was a narrowed peripheral field in his right eye, and comparative blanching of the

retina, with diminution in the size of the arteries. The veins contained less blood than normally, but were not reduced in size. He stayed in the office three hours, his vision gradually improving; and by the time he left it was $\frac{20}{30}$ or $\frac{20}{40}$. The next morning the vision was normal in that eye. In examining the arteries of both eyes I found a very low degree of arteriosclerosis; I believe that this occurs in most of these cases.

A patient, seventy years of age, came to me a short time ago, who said: "In my early years, I had attacks of transient blindness followed by cephalalgia; and when I reached the age of forty-five, these attacks disappeared. The other morning, however, while sitting at the breakfast table, I suddenly had an attack of blindness, such as I had experienced years before, in both eyes. This has continued more or less, but has cleared up to some extent." He stated that he did not have headache, so I told him that the present attack could not be similar to those he had had in earlier years. I found a partial homonymous hemianopsia. It was complete for red and green; but only partial for form.

On observing the case, I found that the visual defect gradually diminished until it was reduced to a very small scotoma. What he had was undoubtedly a thrombotic process, affecting a branch of the posterior cerebral artery. He is gradually recovering.

The first case, it seems to me, was one of spasm. I do not see how a thrombosis could clear up as this case did, and the ophthalmoscopic appearances be such as I have indicated. The tendency to spasm in cases of advanced arteriosclerosis is quite well recognized outside the domain of ophthalmology.

DR. C. F. CLARK, Columbus, Ohio: These cases of transient blindness are interesting and very puzzling. I have been subject, from time to time, to little attacks that were quite a study to me. I can make very little out of them. I thought that possibly there were some changes visible in the retina during the attacks, but I am satisfied that we have attacks of transient blindness that are not due to changes in the eye at all. This has been my conviction for some time. On one occasion, Dr. Hansell was visiting me at my summer home, and, as we had an ophthalmoscope

near at hand, when I had an attack he made a most careful examination of the fundus and found no departure from normal in my case. What these attacks are due to I have never been able to positively decide.

DR. D. W. HUNTER, New York: A good many years ago I was examining a case in the dark room at the Manhattan Eye and Ear Hospital. With me was another young man examining another patient's eye. Suddenly he said, "Why, I cannot see anything." I left my patient and looked at his eye, and in one place the blood stream was broken like the mercury in a thermometer that has been dropped. I do not think that he has ever had another attack.

DR. WILLIAM ZENTMAYER, Philadelphia: It may be of interest to record the subsequent course of the case, which Dr. Harbridge put on record, and which Dr. Weeks has described in his book. The patient had a series of attacks lasting a few days. Active purgation was given, and he was put on a diet, and he never had another attack. He is still living, and the only change that has occurred in the fundus is the development of a low-grade arteriosclerosis. It is well known that spasm is apt to occur in the early stages of this disease, and I believe that some neurologists have explained the hemiplegia of uremia by supposing it to be due to spasm of the cerebral vessels. The man has not changed his mode of life. If this was due to lowering of the blood-pressure, he would have had subsequent attacks; but if it be due to early arteriosclerosis, when the vessels became more hardened the spasm would cease. The effect of toxemia in exciting spasm in such vessels was probably a factor here.

DR. G. E. DE SCHWEINITZ, Philadelphia: On several occasions I have had the opportunity of making ophthalmoscopic examination of eyes very soon after the occurrence of a block in the central circulation. One of Dr. Harbridge's patients, to whom Dr. Zentmayer has referred, I also examined and watched complete collapse of the retinal arteries, followed in four minutes by restoration of their caliber. Also, I have seen, through Dr. Harbridge's courtesy, another one of his patients in whose eye a precisely similar state of

affairs was evident. One of my own patients came to my office within a few minutes after sudden loss of vision, evidently due to obstruction in the central artery, and I watched the retinal edema and the cherry-red spot form within about ten minutes after the obstruction occurred. In this patient, too, the intermittent blood stream in the veins was very evident. The obstruction was a permanent one, and subsequently complete atrophy of the optic nerve took place.

Referring to the question of spasm of the retinal arteries, this I think may be said: While it is true, as Coats maintains, that there is at present no pathological proof that obstruction may be caused by spasm apart from endarteritis, it is equally true from the clinical standpoint that the effect of spasm must be reckoned with. This, I take it, is the opinion of Dr. Duane and Dr. Weeks, who have spoken on this subject. Certainly in experimental work, for example the injection of quinin in animals, the first phenomenon appears to be a very remarkable diminution in the caliber of the retinal vessels. In other words, the first effect of the toxic influence of quinin appears to be to lessen the blood supply of the retina and the optic nerve, although I do not know that it could be proved that such diminution in caliber depends upon a spasm of the arterioles, and yet we know that spasm of the arterioles does take place elsewhere in the body. Why, therefore, may it not be assumed that a spasm may arise in the retinal vessels? I have on a number of occasions watched the eyegrounds of animals in the experimental laboratories of the University of Pennsylvania during anaphylactic shock, but I have never been able to satisfy myself that during the period of my observations there was any alteration in the caliber of the retinal vessels. There has been much speculation as to what exactly the periods of temporary visual obscuration which have been described should be accredited. Perhaps they should be attributed to alterations in the caliber of the central vessel, or to spasm in association with endarterial change, which subsequently is the cause of the permanent obstruction; to spasm alone, which, to quote Hawthorne, is a speculative suggestion and which Coats wishes to eliminate as a factor, perhaps; finally, to temporary arterial collapse, as has been reported by Hoppe, the collapse being

so great that for the time there is contact between the arterial walls, forming a sort of valvular closure, which depends upon a temporary lowering of arterial pressure, so that such pressure is overcome by the intraocular tension.

It has occurred to me that another factor may be an alteration in the quality of the blood itself, although there is no proof of this; but alterations in blood-pressure are doubtless in large measure responsible for many of these phenomena.

DR. W. H. WILDER, Chicago, Ill.: This interesting paper suggests another thought, particularly with reference to possible etiology, that has not been dwelt on at all by any of the gentlemen who have discussed the subject, and that is the importance of differentiating these cases of transient blindness. It is extremely necessary to determine whether there is any hysterical element in the case, nor must we exclude the idea that there may be such an element present, merely because the individual is a male and has reached the age of forty years. We unquestionably do find hysterical manifestations in men past middle life. In younger subjects, particularly, it is important to take this into consideration. Most of us have seen hysterical attacks of amblyopia lasting for a certain period. If there was a curious anomaly in the retinal circulation, we might assume that the difficulty was there. I have in mind a young woman, eighteen or nineteen years old, whose parents I urged to have made an examination of the refraction of the eyes with a mydriatic, somewhat against their wish. Some four or five days after the use of homatropin, when the pupils had returned to normal, she developed complete amaurosis of one eye. This was the only symptom of hysteria that she had, except what developed later, a typical hysterical aphonia. She had no anesthetic areas, and no anesthesia of the cornea. Recovery in about eight months.

In another instance, a young man from a mining school in Idaho came to me for blindness that had developed rapidly in one eye. He passed through Chicago on his way to his home in Washington, D. C., and called to see me. I examined him, and thought that I discovered some areas of anesthesia on his body. There also appeared to be a slight impairment of the retinal circulation in the blind eye. He

was nineteen years old. I referred him to Dr. Wilmer, of Washington, and gave the prognosis to him that in a short time he would see again. I learned that two weeks later he had recovered completely. The subsequent history of this case I do not know.

I know that these cases are not exactly apropos to the subject in hand, but I mention them merely to emphasize the importance of differentiating the etiology of such cases, if possible.

DR. HARRY FRIEDENWALD, Baltimore: I have recently seen a patient whose case comes under this category, but the explanation given by Dr. de Schweinitz is hardly applicable. The man is almost seventy, and has marked cardiac trouble and a high degree of arteriosclerosis from syphilis in early life. He had a sudden attack of partial blindness in one eye, an eye that I had recently examined and found had perfect vision. On the following morning he came to see me, and I found the marked obstruction of one vessel, as shown in the interrupted blood-column, the blood moving very slowly, although in the other vessels there was no evidence of this. I used amyl nitrite and this phenomenon disappeared, but the vision did not improve immediately. The patient was treated for quite a while with iodids, as he had been on previous occasions. In the course of a few weeks there was a reëstablishment of practically normal vision, with a disappearance of almost all the paracentral scotoma. I feel that the explanation of the reëstablishment of the normal caliber of the blood-vessel is quite possible. On the other hand, I cannot agree with Dr. Weeks in his assumption that the presence of headache, following such an attack, is required to prove that it was of the scotoma scintillans variety. I have seen a number of cases in which the symptoms of scotoma scintillans appeared without any headache following. They are rare cases, but they occur.

DR. CLARK: I can confirm the statement of Dr. Friedenwald. I had scotoma of this kind from time to time for a series of years, and no headache with it.

DR. WALTER R. PARKER, Detroit, Mich.: Within the last three months I was called hurriedly to the office of a surgeon who had done an amputation of the turbinate body on the

right side under gas anesthesia. The patient, a middle-aged woman, on recovering from the anesthetic, complained of partial loss of vision in the right eye. Being in an adjoining office I saw her for a very few minutes after she had discovered this loss of vision. The right pupil was widely dilated. With the electric ophthalmoscope, I secured a good view of the fundus and found the upper half had lost its color. The arteries were almost absent from view. I found that the lower portion of the field of vision was entirely gone. At the end of fifteen minutes the arteries had refilled, and she no longer complained of this loss of the lower vision. She was so shocked by the incident that I could not make a detailed examination. She remained in the office where she was operated for two hours and then came to my office, when her vision was normal; and, so far as I could discover, there were no changes in the fundus. The pupil remained partially dilated until the following day, when it was normal in size and reaction. The fields and the acuity of vision were normal. I examined her at intervals for two weeks, and there was no recurrence. It was apparently a case of spasm of the retinal artery incident, probably, to the operation.

DR. H. MAXWELL LANGDON, Philadelphia: There is no question that the majority of these cases have arteriosclerosis, which is the underlying factor, but there are these four or five cases that were not due to that cause. In my own case, the attacks began in early childhood, and in so young a patient as that of Mr. Priestley Smith's, it is hardly possible to conceive of arteriosclerosis. In a patient eight years old it seems to me that there must be something other than arteriosclerosis to explain the condition. The observation of Dr. Parker that the pupil remained dilated is unusual. I have found no cases reported in which contraction was not synchronous with the return of circulation. It is our purpose to try the effect of spasm on the vessels with the rabbit. You can blanch the ear of the rabbit by stimulating the sympathetic, and we intend to note the effect on the retina.

RETINITIS WITH MASSIVE EXUDATION.

HARRY FRIEDENWALD, M.D.,
Baltimore, Md.

During recent years a number of cases of retinal disease have been reported under various headings and often without a more definite title than a "rare and interesting ophthalmoscopic picture." In 1908 Coats collected these cases in a very instructive study, entitled "Forms of Retinal Disease with Massive Exudation."* He states: "There is a disease of the retina, hitherto insufficiently differentiated, which is characterized by the presence in the fundus of large masses of white or yellow exudation; usually there are also groups of cholesterin crystals and hemorrhage. The affection occurs in young people, most commonly of the male sex, whose general health is usually perfect. No definite connection with former illnesses can be established, nor does the family history as a rule reveal anything of importance. The commencement is commonly unnoticed, and the course very slow; in some instances the eye is eventually lost from detachment of the retina, secondary cataract, iritis, or secondary glaucoma; in other instances, quiescence is attained before these results ensue.

"In an allied form of the disease, or in a variety of the same form, strange types of vascular disease are found—fusiform and globular expansions, kinks, loops, glomeruli, etc.—as well as the more common types such as constriction, white ensheathing, etc. The other characters of this group are similar to those of the first, but, probably in consequence

* Royal London Ophth. Hospital Reports, vol. xvii, 1908, p. 440.

of the vascular disease, the cases are less often quiescent and are more frequently followed by the injurious sequelæ mentioned above.

"In the only case of this disease which has so far been examined in a recent stage, the white mass in the fundus was found to be due to a disintegrating hemorrhage seen through the retina, which was thickened and infiltrated with swollen leukocytes. The hemorrhage was connected with the outer strata of the retina and was, therefore, presumably derived from the capillaries of the outer reticular layer, the most external layer in which capillaries normally occur; it had broken through into the subretinal space, and in its periphery slow organization was taking place. The choroid had practically no share in the process. The opaque exudation seen in the fundus apart from the main mass was due to crowds of swollen leukocytes in the subretinal space.

"In the subsequent course of the disease, as shown by other cases, the process of organization is completed and cicatricial contraction sets in, crumbling up the retina and causing further detachment. The hemorrhage breaks down completely and may be totally absorbed; more usually, however, a small cavity remains among the cicatricial tissue, filled with debris, cholesterin crystals and calcareous particles. The disease is now obsolescent, except when vascular disease is present, and gives rise to new hemorrhages.

"There is another form of disease, also with massive exudation in the retina, which is characterized by the formation of arteriovenous communications, with enormous enlargement of the affected vessels. In the youth of the patients attacked, in the absence of an evident etiology, and in its general course and termination, it has many points of resemblance to the cases already mentioned, and possibly it is allied. But the few pathological examinations which have been carried out do not altogether support this, but

Fig. 2.—Case 1. Showing diffuse infiltration of retina.

Fig. 3.—Case 1. Showing massive exudation.

Fig. 4.—Case 1. Same as Fig. 3, highly magnified.

speak rather of a true vascular new formation in the retina. In the meantime, therefore, it is better to classify them separately."

He thus divides the cases into three groups: (1) those without gross vascular disease, (2) those with gross vascular disease, and (3) a very peculiar group, perhaps related to these two, which is characterized by the formation of large arteriovenous communications.

Since the publication of Coats's paper a number of additional cases have been recorded, and there has been much discussion as to their nature. Dr. de Schweinitz, in 1909, presented a paper to this Society* "Concerning a Form of Retinal Disease with Extensive Exudation; being a Clinical Contribution with a Report of Two Cases," and, during the discussion, Dr. Verhoeff mentioned a case which he examined pathologically for me. I desire to describe this case and several others which have since come under my observation:

Case 1.—Mr. L. J. S., aged 18, was referred to me by Dr. Frank R. Smith on May 22, 1905. Two years before he had had typhoid fever in a severe form; had been in bed for five weeks; and for a time his temperature had been 105.5°. There had been no hemorrhages. After convalescence from the typhoid fever spots had appeared before the left eye; he had been up and about for a month; he observed them at first while reading; they were slight at the beginning but gradually increased during several months. He recovered his health and was otherwise perfectly well excepting very definite orthostatic albuminuria, the onset of which is not known but which has persisted unchanged to the present time.

At the time of the first examination I found an extensive retinitis of the left eye, leaving only the macular region fairly free, though even here there were some fine white spots. The whole inner, upper and lower portion of the

* Trans. Am. Ophth. Soc., vol. xii, p. 273.

retina to the outermost periphery was converted into a white surface, in a large part uniformly white, in some places mottled, and in the periphery there were numerous fine hemorrhages like small petechia. In the upper field there was a large prominent mass, whitish in appearance and covered with blood-vessels and numerous hemorrhagic spots. The mass rose precipitately on the side nearest to the disc and its highest surface is seen with +12 D. On the other side it rose gradually. There was no detachment. There

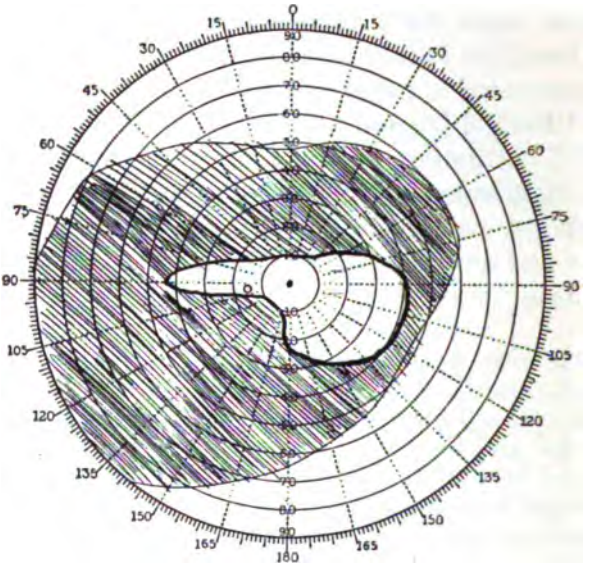


Fig. 1.—Case 1. Visual Field, May 23, 1905.

was a similar, sharply circumscribed, rounded, highly prominent mass in the lower part of the periphery. The upper mass began about 6 or 8 P. D. from and almost above the disc; the lower was still further peripheral. The appearance of these masses was that of choroidal sarcomata, dark, sharply outlined, with precipitous sides and without the wavy surface of detached retina. The margin of the disc was not distinguishable. In the neighborhood of the disc, especially on the nasal side, the retinal surface was covered with

closely placed whitish spots, many confluent. Just below the disc there was a uniform white surface, and this extended around the nasal side and above the disc. This surface resembled a large snow-field. On the nasal side there were many small circular hemorrhages.

The blood-vessels in the affected regions were markedly diseased. They were not interrupted by the exudates. Both veins and arteries were full but not tortuous. The arteries showed abundant sclerotic changes and were converted in some regions into fine threads.

The vitreous was filled with the finest dust-like opacities, and one large baton-like mass and the posterior surface of the cornea was likewise studded with the finest form of deposit.

Central vision was reduced to $\frac{6}{80}$. The field of vision both for form and color was markedly and irregularly contracted.

The right eye was perfect in every respect and has remained so until the present time (May, 1914).

I learned that the patient had been previously seen by Dr. Randolph and Dr. de Schweinitz. Under date of May 26, 1905, Dr. Randolph informed Dr. Smith that he had seen the patient last on October 2, 1903, and that his diagnosis was choroiditis "following probably the attack of typhoid fever." When he saw him "there was considerable pigment change and the vision was $\frac{20}{200}$. There were numerous floating opacities in the vitreous body."

Having seen the patient again in June, 1905, Dr. Randolph wrote: "I feel almost certain that what is now there is simply an advanced stage of what I saw more than a year ago. Everything is on a bigger scale, the opacities in the vitreous are more numerous and are bigger, the areas of degeneration are not discrete as they were when I first saw him, but have become confluent and now the whole fundus, except in some parts, is a big white patch with a number of small hemorrhages on it, in the upper and nasal half of the field, and as de Schweinitz says, is the seat of several cork-

screw-like appearances which are undoubtedly thrombotic vessels. I believe we have beneath the retina the formation of new tissue; in other words, we have a proliferative process which at some points gives rise to a certain amount of retinal elevation and produces the impression as though we were looking at a subretinal neoplasm."

Dr. de Schweinitz saw the patient at this time, and wrote the following letter on June 2, 1905: "Yesterday I examined with much interest Mr. L. J. S., whom you were kind enough to send to me. I have only once before seen an eye-ground like this or, perhaps more accurately, seen one which resembled it. It seems to me that the lesions represent one or two conditions, either an unusual form of choroiditis, or, more accurately, retinochoroiditis following typhoid fever and associated with thrombi in the vessels, probably of the choroid as well as of the retina, because the last-named condition is very evident at the present time; or the so-called chronic tuberculosis of the eye-ground of the diffuse variety, which I think was originally described by Michel. Against the latter is the long duration of the condition without additional destructive changes in the eye, and the absence of any history that very clearly points to a tuberculous lesion. However, tuberculosis is sometimes primary in this region, or gives little or no evidence of its existence elsewhere. I do not see how the question of tuberculosis could be decided without making the test which is so much practised in Germany at the present time, namely, giving test doses of tuberculin, especially tuberculin T. R. In recent times this test has demonstrated that a good many of the processes which we have been accustomed to ascribe to other causes are evidently tuberculous, and a moderate reaction in the eye indicates the nature of the disease. I myself have had no opportunity of making this test in any case, nor do I know whether you would be willing to try it in the present instance; but it would be extremely interest-

ing and in some respects important, and I hope that perhaps you will take it into consideration. The case which I myself had was exactly like this, but in an older person who has since passed from observation, and the cause was never ascertained but was supposed to be influenza. I do not believe that any treatment will clear out these lesions, but would think that, even if the tuberculin itself was not applied, it would be worth while to try the ordinary resolvent treatment of iodids if they were not contra-indicated by the renal condition. Somehow or other I cannot help but feel that there is some connection between the renal condition, whatever that may be, and the eye-ground, especially as the vessels show very decided thrombotic changes. In one place in the eye-ground in the far periphery, as well as in the far nasal periphery, one can see the stopped vessels, and along their course they are twisted and surrounded by numerous hemorrhages, just as one sees them in the so-called apoplexy of the retina. These hemorrhages lie upon the exudate which covers the entire eye-ground in a diffuse manner and lies beneath the retinal vessels and is probably choroidal in its origin. It is a most interesting case and I am extremely obliged for the privilege of seeing it."

On September 12, 1905, when the patient was next seen, the condition had not changed materially. With the left eye he counted fingers at two feet. He had had a fairly good summer until two weeks ago when he had a slight attack of pleurisy.

On September 14, 1905, the weight and general appearance were the same. Under homatropia the media were found to be more cloudy than before. The optic disc was ill defined and on the temporal side and close to the optic disc there was a grayish-white mass running down into a gray-speckled area in or about the center of the retina, and the whiter and more solid mass in the upper, inner and lower fields was about the same as before; the temporal region of

the retina was also invaded by numerous white-speckled masses. The mass in the upper part of the retina was as prominent as before, and there was a large amount of hemorrhage on its surface. In the lower part the mass was as prominent as before. There was the same appearance of small hemorrhagic petechia seen on the inner side of the retina where there seemed to be some prominence. On October 11, 1905, the condition of the fundus was unchanged. On November 15, 1905, there was extensive hemorrhage in the upper inner portion; otherwise there was no change. On May 4, 1906, there was one large floating opacity before the left eye. The optic disc was fairly normal but the margin was completely blurred. The retina in the macular center was still uninvolved, as was also the retina just below the center. There were more hemorrhages than formerly and some of them large. There were some big blotches in the upper part of the retina and extensive degeneration of some of the blood-vessels. The prominent mass was in a large part covered with blood-vessels and hemorrhagic spots.

On July 10, 1906, Dr. Smith reported: "Young S.'s condition is about the same as it was some months ago except that the specific gravity of the urine is lower. His weight is just the same. Lungs are negative. The heart apex beat is a little low (slight enlargement of heart). The specimen of urine passed on getting out of bed had a specific gravity of 1005. There was no albumin to nitric acid test. A specimen passed in my office had a specific gravity of 1015. There was very distinct albumin. No casts were found."

On August 1, 1906, the vitreous opacities had increased so that the background was obscured. The patient was losing weight (from 127 to 120 pounds).

On October 5, 1906, an examination under homatropia showed that the opacities in the vitreous were so marked that it was difficult to distinguish the papilla at all. The opaci-

ties were more marked over the inner half of the retina than in the upper, outer and lower part. On the other hand, the prominent masses appeared to have increased. There were extensive hemorrhages in the upper part of the field and numerous punctate ones as hitherto. The vitreous opacities on the nasal half were probably also hemorrhagic. The punctate and round hemorrhages were most manifest in the inner portion of the retina. The surface blood-vessels of the lower masses can be seen with +20 or +22 D. and the temporal mass with +16 D.

On November 3, 1906, the left eye was slightly inflamed. The pupil was somewhat dilated. There was slight congestion of the eyeball and the tension had increased, but the eye was not very painful to pressure. The iris showed marked hyperemia with blood-vessels coursing over the surface. There was pain over the left side of the head. Eserin was ordered. The tension of the right eye was normal. In spite of the eserin the tension of the left eye remained elevated. On November 12, 1906, salicylate of soda was ordered which relieved the condition in a slight measure. On November 23 the tension was +1, the eyeball was less congested but sensitive to light, the pupil was dilated at maximum.

The patient then consulted Dr. Gruening, from whom I received the following letter dated December 6, 1906: "I examined Mr. S. yesterday and today. If I should name the disease from which he suffers, I would say that he has a hemorrhagic uveoretinitis. In the periphery of the retina the vessels have a corkscrew-like appearance, and several hemorrhagic patches are seen in the vicinity of the altered vessels. The retinal elevation, both in the upper and lower periphery, may be due to cystic formations such as have frequently been observed in inflammatory retinal disease. The eye is hopelessly blind and becomes at times hard and painful. Nothing can be expected from any therapeutic

measure. Iridectomy will avail nothing because the iris is atrophic, and because, even if it were not, hemorrhagic retinitis with tension is not benefited by iridectomy. I would advise the enucleation of the eye, and that without much delay. I also examined the right eye and found it perfectly sound."

December 11, 1906, the tension has varied from +1 to +3. The entire macular area was now converted into a white surface, so that the involvement of the retina was now complete.

On May 6, 1907, a well-marked cataract was observed which had developed in the course of a few weeks. The eye continued in a condition of irritation during the summer of 1907, and, after consultation with Dr. Theobald, enucleation was agreed upon and performed on September 10, 1907. The eyeball was placed in formalin solution and sent to Dr. Verhoeff, whose report I append:

"After hardening in formalin, the globe was sectioned without freezing. Diameters of globe: Anteroposterior 24.25 mm., vertical 23.5 mm., horizontal 24 mm.

"The cornea, 12 mm. by 10.5 mm. by 8 mm., is clear. The anterior chamber 1.5 mm. is deep and free from coagulum. The pupil, 8 mm. wide, is free from adhesions. The root of the iris blocks the filtration angle all around. The lens, 10 mm. by 5 mm., is in situ, cloudy and unusually soft after formalin fixation. The vitreous humor is of normal consistency and clear except for a small amount of blood diffused from small hemorrhage which has taken place from region of ora serrata below. There is also a small amount of blood plastered on the posterior surface of the lens. The ciliary body is atrophic. The retina and choroid are in situ. The retina shows numerous yellowish-white patches with fairly sharp outlines which are slightly elevated above the surface. The largest of these is situated below and has the shape of an equilateral triangle with its apex at about 5.5 mm. from the disc and its base exactly at ora serrata; its sides are 1 cm. in length. Within this patch there is a de-

posit of glistening material, 1 mm. in diameter, evidently cholesterin. Separated from this large patch there are five similar patches, rounded in shape, which measure from 3 mm. to 5 mm. in diameter. None is nearer than 5 mm. to the disc. When one of these patches is incised, glistening cholesterin crystals are set free in abundance. In addition to these, there are numerous punctate spots. On the temporal side, extending from the margin of the macula, there is a horizontal band 3.5 mm. wide which is made up of these punctate spots. Only one branching pigmented figure is to be seen, which is situated just back of the ora serrata. The macula appears as a gray area with a dark spot in its center. There are no retinal hemorrhages. The choroid is apparently normal. The disc shows a deep cut with overhanging edges. The nerve stem is gray and translucent.

"Histological examination: Embedding in celloidin. Horizontal sections made of anterior part of the eye and of the entire fundus, the latter including the optic nerve to one-third of its diameter. Serial cross sections made of remaining portion of nerve, including central retinal vessels from base of optic excavation to cut end of nerve (Figs. 2 to 6).

"The iris is normal. It is atrophic, shows ectropion uvea, and is firmly united with ligamentum pectinatum and cornea at its root, thus completely occluding the filtration angle. The ciliary body shows advanced atrophy, and the ciliary processes are pulled forward and elongated. The lens has almost entirely lost its normal fibrillated structure, and shows numerous vacuoles and clefts due to softening. At the posterior pole it is broken up into hyaline balls. The capsular epithelium has not undergone proliferation, but shows the abnormality of extending entirely around the lens, although it is much thinner posteriorly. The posterior capsule is unusually well developed.

"The choroid is normal except in certain places where the retina is fused with it, in which it is infiltrated with chronic inflammatory cells. The membrane of Bruch is normal except near the disc where it shows degenerative changes. The pigment epithelium shows no colloid bodies but in places there is loss of pigmentation and in others marked proliferation.

"The retina shows advanced atrophy and is everywhere involved in an overgrowth of neuroglia. The layer of rods and cones has entirely disappeared, and the membrana limitans externa can only occasionally be seen. The nuclei and fibrils of the external nuclear layer as well as the bipolar cells of the internal nuclear layer are much distorted but can usually be recognized as such. The multipolar ganglion cells have entirely disappeared. In places, especially within the large white patches seen microscopically, the retina is adherent to the choroid and largely replaced by hyaline fibrous tissue. There are no retinal hemorrhages to be seen. There is much pigmentation due to migration of cells of the pigment epithelium. The pigment cells occur isolated throughout the retinal layers but more often in clumps situated along the outer surface or in the outer nuclear layer. Many of the proliferated pigment cells are multinucleated. There is no tendency for the pigment cells to group themselves about the blood-vessels. Almost all of the pigment in the retina is readily bleached by the method of Alfieri and fails to give the iron reaction. A small amount of pigment giving the iron reaction is, however, seen here and there. In places the retina shows deposits of lime salts (Figs. 5 and 6). The spaces left by cholesterin crystals are not obvious except within the hyaline fibrous tissue where they are often plainly seen. In the macula the retina is reduced to a thin layer of neuroglia which in the foveal region contains a large number of migrated pigment cells. The retinal vessels show advanced degenerative changes, many of them being completely obliterated and converted into hyaline columns.

"The optic disc shows a deep hollowed-out cup lined by a thick layer of proliferated neuroglia. The nerve stem is completely atrophic, and shows an abnormal vascularity, due no doubt to the establishment of a collateral circulation.

"The central artery shows advanced endarteritis in all the sections. At the cut end of the nerve the lumen is almost completely occluded by endothelial proliferation and still farther back was probably entirely so. Anterior to this the lumen again becomes of almost normal size and contains normal blood, but just behind the base of the optic

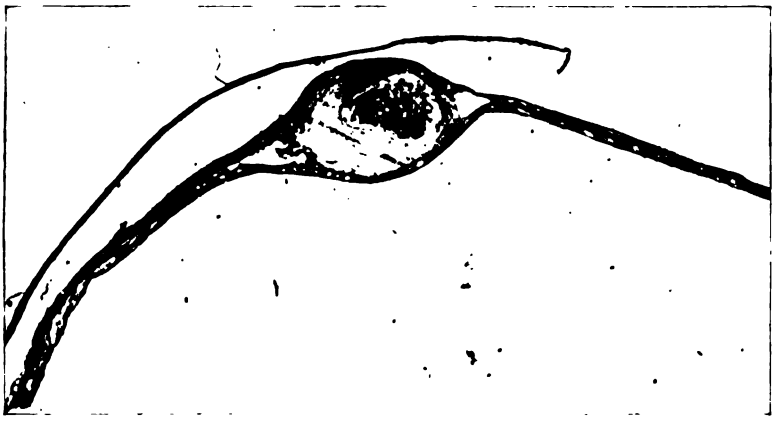


Fig. 5.—Case 1. Exudate in retina, with deposit of lime salts.

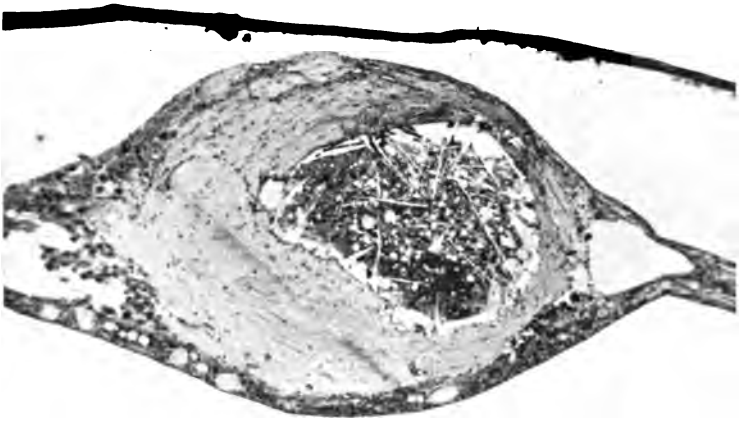


Fig. 6.—Case 1. Same as Fig. 5, highly magnified.

excavation it is again occluded, apparently completely. During life, however, it is possible that there was still a minute lumen here. The obstructions in the artery in both places are evidently old, judging from the faint staining of the proliferated nuclei and the density of the intercellular substance.

"The central vein shows endophlebitis which, however, is marked only just behind the base of the glaucomatous cup. Here the lumen is completely occluded by endothelial proliferation. The nuclei stain deeply and are closely set, indicating that the obstruction is more recent than that in the artery. Changes similar to those found in the central vessels are also to be seen in some of the posterior ciliary vessels.

"Diagnosis: Obstruction of central retinal artery and vein due to proliferative endovasculitis. Marked degeneration of retinal vessels. Advanced atrophy and degeneration of retina. Complete occlusion of filtration angle. Advanced secondary glaucoma."

The following letter was received later from Dr. Verhoeff. It is dated November 25, 1907:

"I was much interested in the clinical account of the case which you sent me. It was a surprise to learn that the patient was only twenty years old, as the marked vascular changes led me to believe he had reached the senile stage. I suppose you can exclude syphilis as the cause of the arteriosclerosis. In regard to your question as to whether or not the retina showed any large elevations, I can say positively that it did not. I opened the eye by means of a coronal incision just anterior to the ora serrata all around, and had a perfect view of the fundus. Probably the elevations you saw were due to localized œdema or to localized separations of the retina which afterwards disappeared. It is difficult to see how the large patches in the retina could have been due to anything other than old hemorrhages, but I must confess that I have never seen such marked degenerative retinal changes in any of the other cases of obstruction of the central vessels that I have examined. I have, however, seen the hemorrhagic areas take the size and shape of the patches

in your case. I was puzzled to explain the softness of the cataract in your case, but of course it is explained by the age of the patient."

The patient has been seen from time to time and no changes have been discovered in the right eye.

The pathological process observed both clinically and microscopically places the case without doubt among those described by Coats. No adequate cause could be found. The affection began definitely immediately after convalescence from typhoid and I am convinced that this was not a coincidence. Lues was excluded. The physician, a man of wide experience, under whose care the case was treated for many years, saw no evidence of tuberculosis and was unwilling to submit the patient to subcutaneous tests. The microscopic appearances, furthermore, were incompatible with tuberculosis. The masses lying between the retina and choroid, composed of hyaline connective tissue with calcareous infiltration, represented organized exudates. The absence in the sections of any evidence of the large cyst-like "neoplasms" clearly seen during the earlier history of the affection is to be explained only by the absorption of the underlying fluid, and I would suggest that this may have been brought about by the continued high intraocular pressure. The termination of this condition in glaucoma is not uncommon.

In this case small hemorrhages and sometimes quite large hemorrhages were frequently observed in the retina and furnish additional evidence for Coats's view that the retinal opacities are due to underlying hemorrhages.

Case 2.—Mrs. C., aged about twenty-two, was admitted September 21, 1909, to the Baltimore Eye, Ear and Throat Charity Hospital, having been referred to me by Dr. I. R. Cole, of West Virginia. Both parents were living and in good health, as were likewise six sisters and two brothers. One

brother had died in infancy. The personal history is negative, but a statement of definite syphilitic infection was subsequently obtained from her family physician.

Both eyes had become inflamed three years previously. The trouble came on suddenly and was painful. The left soon became well. She thought that a "speck" had been visible in the eye before the inflammation. The right eye had had convergent strabismus. The vision had been lost but she did not know when she had become blind. A cataract operation had been performed on the right eye in January. The eye was slightly painful before the operation and remained so after the operation.

On her entering the hospital there was no light perception in the right eye, while the left was perfect with +1 sph. The right eye was somewhat congested; the iris was bombé, the pupil irregular and filled with a cataractous mass; the iris was discolored; the anterior chamber shallow; tension was normal.

On September 21 extraction of the capsular cataract was performed. The mass was removed without difficulty; the irritation which followed during the period of healing was slight; but the pupillary space was soon filled with fresh opaque matter, and it was never possible to inspect the interior of the eye.

In the meantime, the patient began to complain of occasional discomfort in the left eye. On October 7 an examination with the ophthalmoscope revealed serious trouble. The central vision of this eye was still perfect, but in the lower inner portion of the retina there was an extensive white lesion in the middle of which was a well-defined prominent mass which I feared might be a sarcoma. I had my colleagues examine the eye and they concurred in the probable diagnosis.

The eye was free from irritation; the disc was congested; the veins stood out and were very tortuous. A white exudative infiltration covered the inner nasal portion of the retina, did not come up to the horizontal line, while it extended beyond the median line below. The nearest approach of the mass to the optic disc was five to six P. D. The lesion was in large part a vast white surface with here and there a mottled mass. Markedly enlarged and tortuous vessels

passed over the surface. In its center there was a large bluish "neoplasm." (?) The highest portion of its surface could be seen with +10. It rose abruptly. The tension was normal.

The question of tuberculosis having arisen, a tuberculin test, made by Dr. Hamman in November, produced marked general reaction only; tuberculin injections were given under his direction. No improvement resulting, this treatment was discontinued on December 13 and mercurial treatment was instituted.

Repeated general examinations threw no further light upon the case. The blood-pressure was 125; the heart-sounds normal. The examination of the blood showed the following:

Red cells, 3,980,000; hemoglobin, 80+; white cells, 7800. Differential count showed: Small mononuclear leukocytes, 23.6 per cent; large mononuclear leukocytes, 7.2 per cent; polymorphonuclear leukocytes, 67.1 per cent; eosinophiles, 2.1 per cent. The specimen shows only a very mild anemia. Nothing otherwise abnormal observed.

The urine examination showed: Reaction acid; specific gravity, 1022.5; albumin and sugar, negative. Microscopically: epithelial cells, amorphous urates, bacteria, nothing abnormal.

Mercurial and iodid treatment was continued vigorously but there was steady progress of the retinal disease lesion and diminution of the field of vision. From a large number of field records I select a few. Central vision remained perfect until the middle of May. The manner in which the extension progressed was characteristic and interesting. The extension of the area of exudation and diminution of the field was not a gradual process, but, after varying through short periods of quiescence, there were evidences of sudden progress, so that during the frequent examinations we could

observe from time to time how the line of demarcation had been pushed forward, a fresh sector or band having been added to the old and becoming inseparable from it.

On June 1, 1910, the patient reported that for the past two weeks there had been some color disturbance. When she looked at objects there was a noticeable blue tinge to the surrounding air. This blue was most noticeable above the object and was most marked at night. Occasionally the

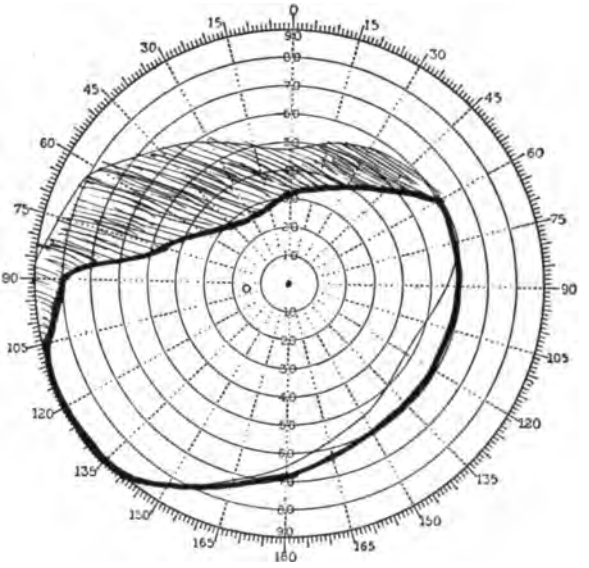


Fig. 7.—Case 2. Visual Field, October 20, 1909.

color was red and less often yellow. There were times when this disturbance was absent. It only disappeared for short intervals of time, half an hour to an hour, and afterward the color disturbance was worse, if she went out in the light.

On June 10, 1910, there were numerous hemorrhages in the healthy part of the retina; one a large round hemorrhage into which a blood-vessel apparently ended. There were

also a number of hemorrhages in the white area. On June 20, 1910, the vision was $\frac{1}{20}^{6}$ with difficulty. I had a drawing made about this time, which was quite accurate, except that in size the veins appear narrower than they really were. (Colored Plate I.) The optic disc was not definite in outline. There were some fine vitreous opacities. The retinal refraction was the same throughout, except in the elevated area below and to the nasal side, where it sprang forward and could be seen with +12 D. sph.

On July 24, 1910, the patient noticed a marked decrease in her visual acuity and described it as though she were looking through smoke. There was also an increase in the floating spots.

On July 26, 1910, the right eye was enucleated. The eye was found to be soft. Within there was a hard formation taking in about two-thirds of the circumference of the globe in the region of the equator. The recovery from the operation was uneventful. The decrease of vision of the left eye continued.

On August 23, 1910, there was constant dull pain. The vision was $\frac{1}{200}^{6}$, by looking just above the object to be seen. Along the margin of the retinal exudate the dark spots of pigment were less noticeable than they had been before. There was an increase of the white area. Throughout the blind part of the retina the white patches were much more dense. The veins had increased in size, while the arteries had decreased until they were little more than mere threads.

On September 3, 1910, the patient complained of the vision being very much worse for the past three days. She could make out hand movements at two feet and only in the central lower portion of the field and for a short distance on either side of the midline. The area of previously healthy retina, which was above the disc and to the temporal side, was now studded with small white spots of various sizes.

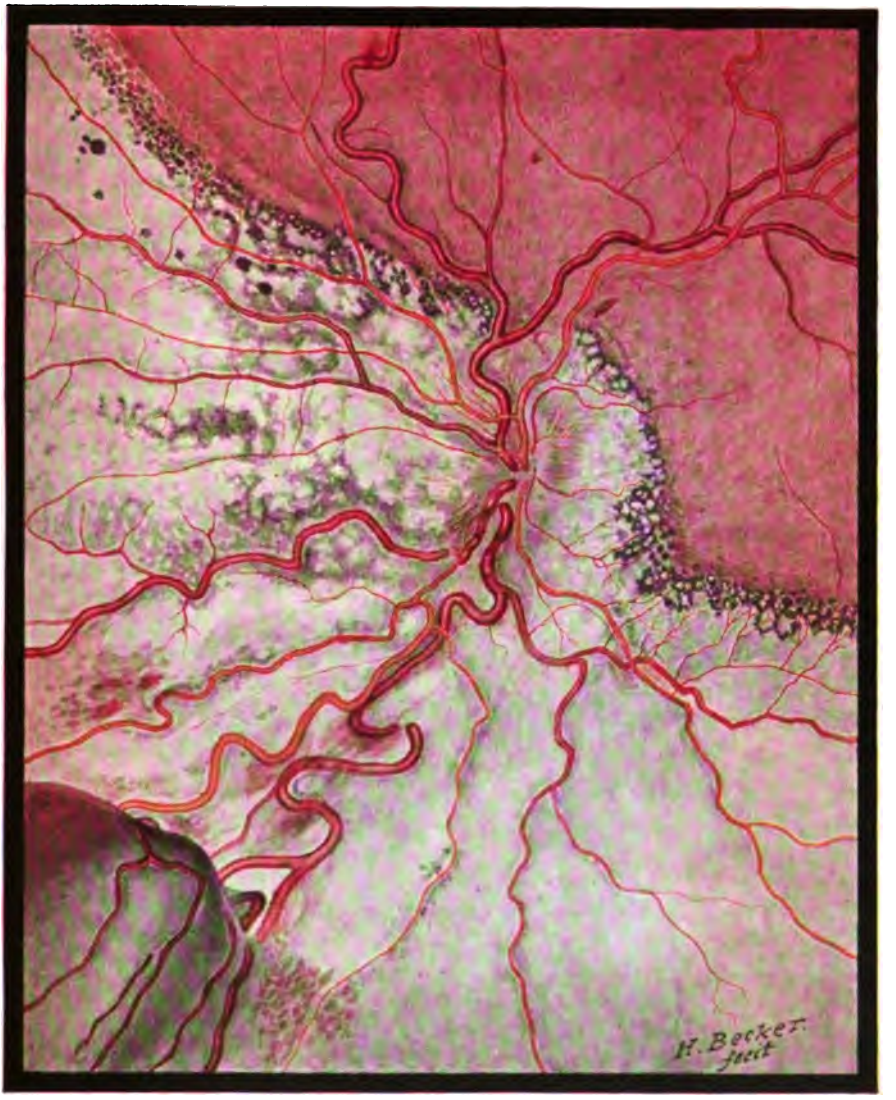


Plate 1.—Case 2. Retinitis with massive exudation.

There was no longer any healthy retina. Below and toward the periphery there was a large field of white. This had increased in size. The disc could only be made out by the convergence of the veins. Vitreous opacities were more numerous than previously.

On September 15, 1910, the vision was equal to hand movements at a couple of feet and only in the temporal and lower portion of the field. The congestion of the sclera was slight. The entire fundus was involved, and there was very little red retina between the white areas. The tension was normal. There was a detachment of the retina with all the characteristics of a marked detachment. In the lower temporal region it rose to almost +14, in the upper nasal to +4 or +5, and in the lower nasal region to about +11. The vitreous was cloudy. On September 16, 1910, I allowed the patient to go to her home. She returned for examination and on November 19, 1910, Dr. Randolph, who had kindly interested himself in the case, wrote as follows:

"Thank you very much for permitting me to see your patient who has the interesting eye-ground changes. I am more than ever of the opinion that the condition is either luetic or tubercular. I think it is an enormous hyperplasia of the choroidal elements, very localized in character and involving also the outer layers of the retina, with probably a complete disappearance of the pigment layer of the latter."

I hear from the patient from time to time, but no change has occurred nor has her general health suffered.

The pathological examination of the right eye, which had been removed, was made by Dr. Standish McCleary, who furnished me with the following report:

"A horizontal section through the equator of the eye shows that more than half of the area normally filled by the vitreous is occupied by a mass measuring 0.9 by 0.6 cm. The lens is missing. The vitreous is more cellular than normal and contains newly formed capillaries.

"The mass of tissue above mentioned is firmly attached to or rather continuous with the retina at one point and laterally is connected by a delicate reticulum of hyaline fibers. At the point of attachment the tissue is fully organized fibrous tissue, and is loaded with pigment which can be directly traced to the pigmented layer of the retina. The greater part of the mass is quite cellular and contains a great number of blood-vessels which are in immediate contact with the cells (Fig. 10). A low-power view is strongly suggestive of glioma or sarcoma. Careful study

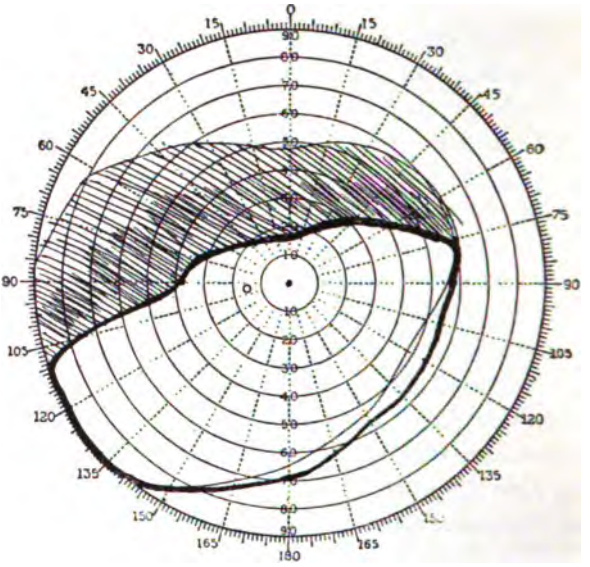


Fig. 8.—Case 2. Visual Field, March 19, 1910.

of the mass with higher magnification shows a great diversity both in the character of the cells and the amount and nature of the intercellular substance in various fields (Fig. 11). Some individual fields present an exact picture of mixed-cell sarcoma, but adjoining them can be seen areas of lymphocytes, plasma cells, fibroblasts and developing connective tissue in all stages from the faintest fibrillation to well-matured tissue. Beautiful fibrin network, as well as masses of hyaline and canalized fibrin, are seen in the less cellular areas.

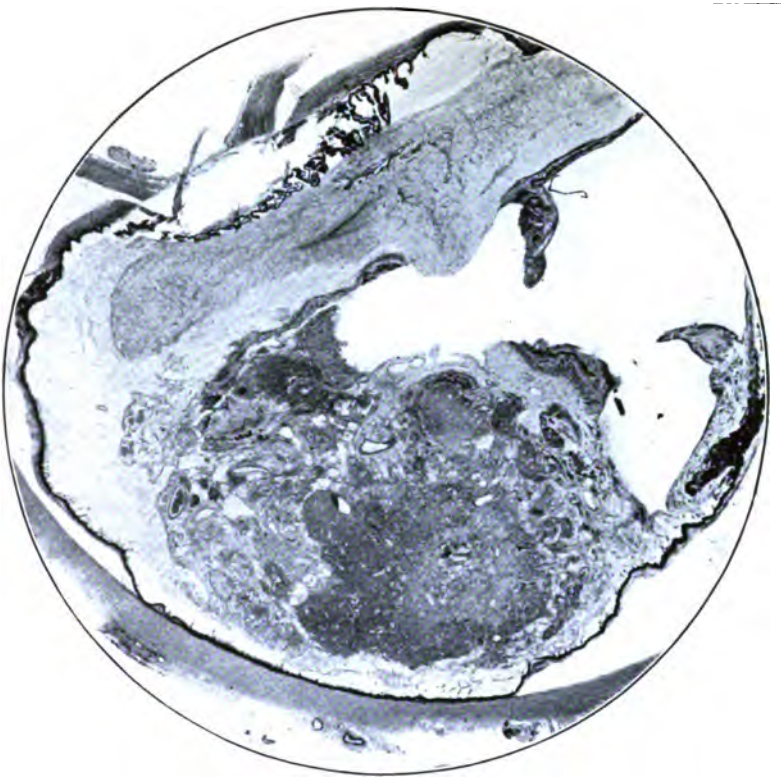
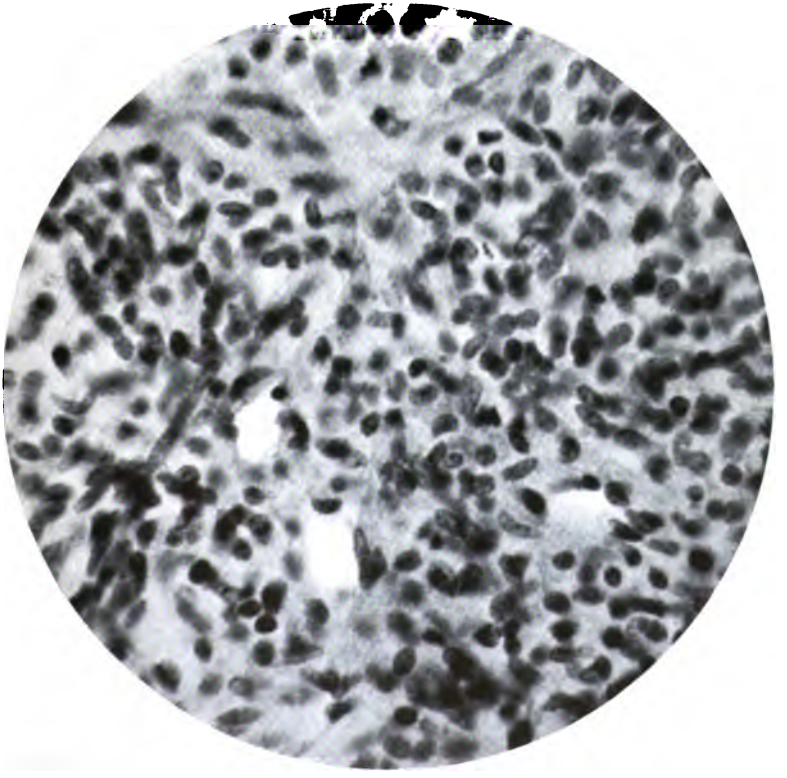


Fig. 10.—Case 2. Showing mass of inflammatory exudate in retina.



"The study of the blood-vessels of the mass is instructive. Some of the vessels are quite fully developed, and in some there is a distinct hyaline degeneration; others consist of but an endothelial wall, although they have attained considerable size. The development of new capillaries can be easily demonstrated in certain areas. In following the circumference of the retina a spot is found from which all layers down to the pigmented are absent, and the pigmented layer is much thickened by laminæ of dense fibrous tissue which is undoubtedly of inflammatory origin.

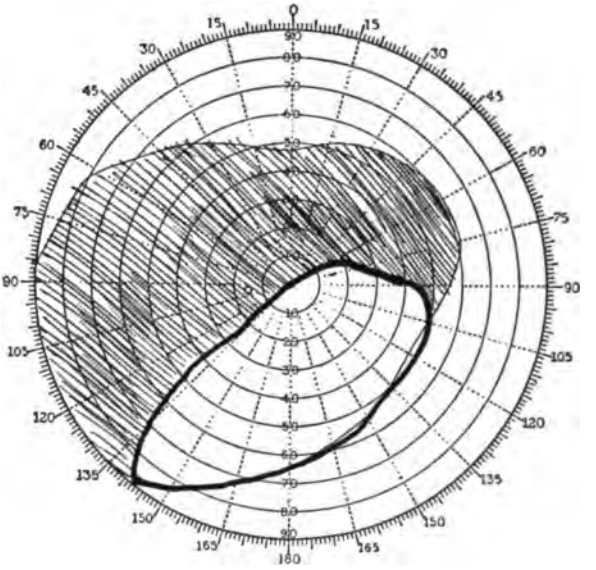


Fig. 9.—Case 2. Visual Field, August 19, 1910.

"The question in this specimen is to decide between a neoplasm and an organizing inflammatory exudate. While there are a few fields in which the structure of sarcoma or glioma is closely simulated, taken in its entirety, we seem to be dealing with a massive retinal exudate gradually becoming changed into connective tissue. Another section made in the same plane, but on a lower level than that just described, shows chronic choroiditis. The choriocapillaris

is almost obliterated, and is covered by several layers of connective tissue of varying density, in some of which pigment is abundant and hyaline degeneration is seen. As this newly formed connective tissue is followed it becomes broader, and beautiful areas of forming and mature osseous tissue are seen. The haversian canals, lacunæ and lamellæ and osteoblasts are typical. This section is a typical picture of ossifying choroiditis."

It is not possible to affirm that the retinal affection of the two eyes was similar, but it is probable, and that both depended on the syphilitic infection, though vigorous and long continued antisyphilitic treatment had no influence on the course of the disease. The appearance simulating glioma, but unquestionably inflammatory in character, calls to mind the case of Knape, who in 1908 reported a case of von Hippel's disease, presenting the picture of glioma of the retina*. The patient was a boy, aged ten, with massive retinal exudate and extensive angiomatosis. The eye had to be removed for secondary glaucoma and the pathological examination showed conditions quite similar to those found in the case I have just reported.

Meller more recently tries to prove that the form described by von Hippel, and classed by Coats under the third group, must be regarded as a gliosis retinæ diffusa teleangiectodes, a glioma formation similar to that of the central nervous system, a primary increase of the neuroglia with secondary vascular changes. He calls attention to the fact that Goldzieher had years ago expressed the same view.†

Cases very similar to those described may at times occur in albuminuric retinitis, as in the following:

Case 3.—A female child, aged eleven, a patient of Dr. A. C. Harrison, in June, 1909, at St. Joseph's Hospital, pre-

* Arch. f. Augenheilk., vol. lx, p. 49. v. Hippel has recently thrown doubt upon this case because of the marked and unexplained disagreement between clinical and pathological pictures.

† Arch. f. Ophth., vol. lxxxv, p. 255.

sented high arterial tension and rapid pulse; the urine had a specific gravity of 1010 and contained much albumin. There was marked dropsy. The child was blind for one or two months, and showed an extensive detachment of the retina in the right eye; in the depth I saw some hemorrhage and probably neuritis. The detached retina was thrown into globular folds.

In the left eye there was the most intense form of neuro-retinitis, with great swelling of the disc and the development of masses of capillary blood-vessels. There was one large mass projecting some distance into the vitreous. There was also massive white exudation toward the nasal side and likewise in other parts of the periphery. In the lower periphery there was incipient detachment. The patient died four weeks later. I report the case only to point out the similarity of the ophthalmoscopic appearance.

The following case is typical, and is under observation:

Case 4.—Irvin B., aged four, was brought to me on November 12, 1912, the parents having noticed occasional divergent strabismus. With the exception of an attack of diphtheria, the child had always been healthy. The parents were healthy, as were likewise two other children.

The left eye was quite normal in every respect. In the right eye the entire central retinal region was converted into an intensely white surface, covering a large and extensive area and involving both the disc (which had the appearance of an intense neuritis) and the macula. The appearance of the retina was similar to that of Cases 1 and 2, before reported. The white area of infiltration does not pass directly into the normal area, but there is a border of small white spots which gradually fade into the healthy retina. With a +14 lens, dust-like opacities are found in the vitreous. The blood-vessels show no marked alteration aside from definite enlargement of the veins.

The patient was referred to my brother, Dr. E. B. Friedenwald, who reported, after a most exhaustive examination, that the child appeared healthy in every respect. A von Pirquet test was made on November 26, 1912, and was definitely negative. The child has been seen a number of times since.

On June 13, 1913, I found no definite evidence of extension. On December 24, 1913, a number of crystals had made their appearance over the white field. Still, there was no extension of the infiltration. On April 23, 1914, I found very definite vascular changes in the form of masses of minute vessels together with hemorrhages in the extreme temporal periphery and in the lower periphery. The left eye remained normal.

The condition at present (May, 1914) is as follows: The optic disc is blurred in outline. Only the temporal side can be made out and is somewhat blurred. There is slight connective tissue formation in front of it; to the nasal side the retina looks normal. The massive exudation begins close to the disc and involves the entire macular region as well as above and below, going far out into the periphery. It is slightly yellowish in color. It does not appear elevated. The blood-vessels pass in fairly straight lines over it. Above the disc there are speckled white spots; below the disc and outlining the big mass there is likewise the speckled condition. The surface is fairly uniform and contains numerous brilliant crystals and some darkened pigmented masses over the exudation. There are some minute hemorrhages. The vessels show some enlargement but no marked pathological changes, excepting in the farthest temporal periphery where there are the characteristic fusiform enlargements and masses of convoluted vessels. The vitreous contains some very fine dust-like opacities. There has been definite extension in the direction of the temporal periphery, and it is in this region that the vascular changes are now clearly seen. I do not believe that I could have overlooked them during the earlier examinations, and feel reasonably sure that they have developed since.

This case is similar in appearance to those described excepting that, while the others first involved the peripheral portion of the field and only later attacked the macular region, in this case it is the macular region which is primarily affected and there is an absence of the prominent cyst-like masses seen in the other cases. But there is definite and marked vascular disease.

This case may belong to those which have been described as probably being congenital, but I hesitate to suggest this in view of the evidently active though slight progress.

The following case likewise involves the central retinal area, but the picture is quite a different one:

Case 5.—Mr. T. C., aged seventeen, a splendidly developed young man, six feet tall, and one of the best athletes in his school, was referred to me on March 14, 1914, by his physician, Dr. Cary B. Gamble. During the previous summer, while shooting, he had accidentally discovered that the sight of the right eye had been lost.

He had had the various affections of childhood, such as measles, mumps, and chicken-pox; and had attacks of malarial fever for a number of years, having lived in a malarial district in North Carolina until six years ago.

Dr. Cary B. Gamble reported as follows: "Mr. C. consulted me March 9, complaining of pain over the left eye; father has parathyroid insufficiency, mother normal. Patient has had the usual diseases of childhood; never had scarlet fever. One year ago, after a hard tennis game and a motorcycle ride, was much overcome. At this time was examined by Dr. Adler, and the parents were told that the blood-pressure was high. Three months ago he had an infection of his frontal sinus.

"*Examination.*—Unusually large boy for his age, looks like a man of twenty-one; slight enlargement of the forehead and jaw. His face has changed since the last time I saw him two years ago; lungs normal; heart apex slightly out, otherwise negative; blood-vessels palpable; blood-pressure 160; no syphilis; blood-count normal; hemoglobin normal; urine, no albumin, a few hyaline casts. The boy is noted for the length of time that he can stay under water while diving.

"The change in the boy's appearance, especially as regards his face, his forehead and his jaw, leads one to suspect pituitary trouble. The blood-pressure, his normal blood-count, the fact that he has had no lues, the presence of a few casts in his urine, lead one to suspect interstitial nephritis.

"March 18, 1914. Blood-pressure 160; urine condition improved; ordered iodid of potash, 3 grs. three times a day.

"May 10, 1914. Condition since last note has improved. Systolic blood-pressure averages 150. Is taking K. I., grs. v, t.i.d. Three weeks ago found an abscess in right tonsil which drained from above; opened freely below with electric cautery. With sinus trouble in the past, and abscess in tonsil, there is a history of infection running over a period of at least one year.

"May 16, 1914.—Urine, no albumin; few hyaline casts. Dr. Baetjer reports that *x*-ray plate shows no enlargement of sella.

"*Diagnosis.*—Interstitial nephritis following infection of sinus and tonsils."

Examination of Eyes.—The central vision of the *left* eye $\frac{20}{15}$ and the field quite normal. Under homatropin the disc, the retina and the vessels show absolutely normal conditions. The central vision of the *right* eye was entirely lost, but the peripheral field was retained on the temporal side in half-moon shaped form (Fig. 12). The ophthalmoscopic examination revealed a picture similar to that generally described in Germany as von Hippel's disease. The blood-vessels on the disc, both arteries and veins, are considerably enlarged. The disc is markedly hyperemic and blurred in outline. Toward the nasal side conditions that prevail are perfectly normal, aside from a little increase in the width of the veins. In one place the superior nasal vein shows a slight narrowing. In the upper inner part of the retina there is a fluffy mass of white opacities made up of very small spots. Above the disc similar spots are seen. In the macular region the changes are most extensive. The whole area over the disc, and considerably beyond the macula and in a rough circular manner extending upward, is one large mass of degeneration in which the retina is in part detached and can be seen with+8. In this area there are numerous red spots which at first sight appear hemorrhagic but which on closer examination are seen to be convoluted and enormously dilated veins. In some areas capillary vessels appear in enormous numbers. In other areas there are convoluted masses in which the caliber of the veins varies greatly, often becoming sausage-like in appearance. Beyond this area the veins also show enormous variations in caliber, with frequent

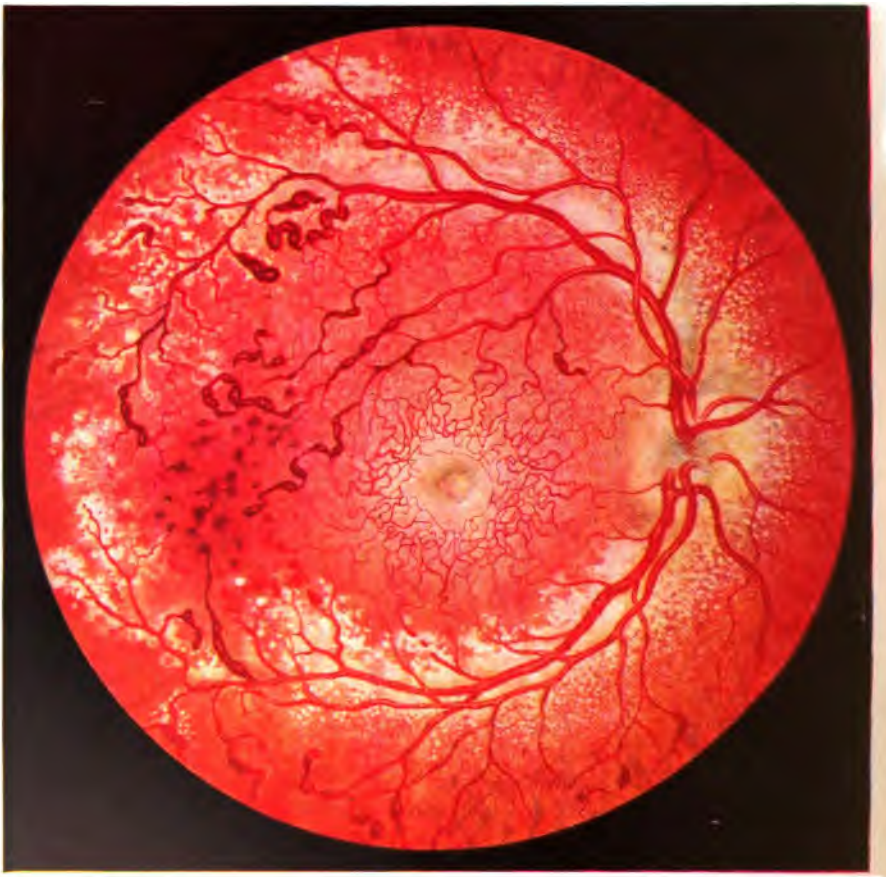


Plate 11.—Case 5. Retinitis with massive exudation, showing marked arterial and venous disease.

varix-like enlargements. In the far periphery the changes seem to be very slight.

May 11, 1914, the condition practically remains unchanged, and is well shown in Color Plate II. The only errors in the drawing are that the retina on the nasal side of

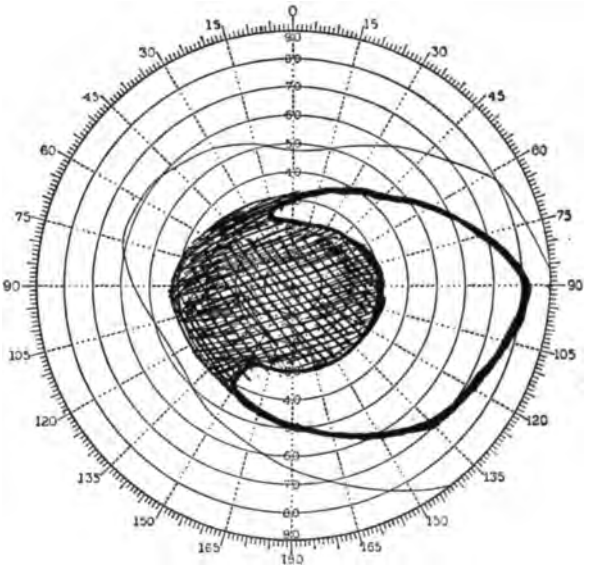


Fig. 12.—Case 5. Visual Field, March 16, 1914. Heavy black line red. Tested by placing red glass over left eye, using the eye for fixation, and testing the right field with 1.5 cm. circular red spot.

the disc is almost perfectly normal, and the white spots shown do not extend quite around the disc. The blood-vessels in the diseased area can not be recognized by their appearance as arteries or veins unless they are followed up to their sources. Some of the veins have a very marked light reflex. The bulbous enlargements are not only seen in the veins but also in the arteries. The white area extends down somewhat lower than in the drawing. In the temporal periphery there are evidences of diseased blood-vessels beyond the area of the exudate. The vitreous

contains very fine opacities but not in great abundance. The difference between the highest point of the mass and the normal retina is 5.5 to 6 D.

This case belongs to the class which Prof. Leber* recently described as a separate form, and of which he has found eleven examples published besides two which he has himself observed. He regards the disease of the blood-vessels as the primary lesion. The situation and general form bear a certain resemblance to retinitis-circinata. But all of the cases occurred in males between thirteen and twenty-six years, while retinitis circinata is much more common in the female and at a later period of life. No satisfactory explanation is given.

Etiology.—In the cases reported I have found syphilis in one, typhoid fever with orthostatic albuminuria in a second, and excessive arterial pressure and nephritis in two. In the fifth, the youngest, no cause can be found. But is it proper to assign these varying conditions as the causes? Others have been unable to discover any of them. Tuberculosis certainly played no part in any of my cases. The difficulty of finding an etiological explanation has been baffling to all who have interested themselves in these cases. Hajano, in a recent paper in discussing his own cases, expresses himself very naively: "Alle Kranken waren vollkommen gesund."

In a recent article Coats† summarizes our present knowledge as follows:

"It is possible to differentiate a retinal affection in which prominent lesions or areas of white or yellow opaque exudate lying under the retinal vessels are the characteristic feature.

"In some cases there is absence of vascular disease or it is seen in mild form; in others it is a marked feature, and

* Leber, "Ueber eine durch Vorkommen multipler Miliaraneurismen charakterisierte Form von Retinaldegenration," Archiv f. Ophth., 81, p. 1.

† Archiv f. Ophth., 81, p. 275.

there are not only the common varieties but also rare forms such as fusiform or globular dilatations, loops, glomeruli, etc. The affection is commonly found in young persons and more frequently among males. It is scarcely ever possible to discover any probable cause either in the personal or in the family history.

"The disease begins stealthily and progresses very slowly but has a tendency to extend, fresh areas of exudate and new hemorrhages appearing while the older lesions may partially or entirely disappear. In the later stages detachment of the retina, secondary cataract, iritis, decrease of intraocular tension or glaucoma may lead to loss of the eye, but some cases may come to a standstill before such consequences appear. The pathological appearances demonstrate that hemorrhages in the outer layers of the retina are the cause of the affection. The hemorrhage probably begins in the outer reticular layer and breaks through into the subretinal space where it undergoes slow organization and becomes converted into cicatricial connective tissue. The choroid takes part only in a later stage.

"Vascular changes, if present, chiefly affect the veins and occur as (1) dilatation with slight change in the vessel wall; (2) thrombosis; (3) collections of leukocytes in the vessel walls and in the perivascular lymph spaces; (4) thickening and hyaline degeneration; (5) endothelial proliferation; (6) a peculiar condition of incomplete staining and fragmentariness of the nuclei of the endothelium and of the fibrous wall.

"Regarded clinically, he would propose to call the affection *retinitis exudativa;* or from the pathological aspect *retinitis hemorrhagica externa.*

"The final cause of the hemorrhage is doubtful and is perhaps not identical in all cases. Possible explanations of individual cases may be hemorrhage at birth, hemorrhage caused by whooping-cough or hemorrhage produced by trauma. Those cases which are known to have appeared in later life or those which manifest progress while under observation cannot be explained in this manner. We must assume a change in the composition of the blood for which there is as yet no evidence or local vascular change in the affected eye.

"It is natural to assume that the vascular changes are the cause of the affection, and this may at times be the case. But there is the objection to this view, (1) in the fact that the distribution of the vascular changes and of the exudate do not always correspond; (2) that the exudate may occur in regions where the vessels have been found normal on examination; and (3) that some cases show no changes or but slight vascular changes throughout their course. There is also the difficulty of explaining why such vascular changes should occur in young and healthy persons and only in one eye and only in the branches of the second or third magnitude. For these and other reasons it is probable that some and perhaps all of the vascular changes are secondary, and that they develop as the result of thrombosis from cicatricial contraction and as a consequence of the action of certain toxins which arise from changes in the blood.*

"But the theory of local vascular disease is after all the most satisfactory. It is possible that the vascular disease is of such type as can neither be recognized by the ophthalmoscope or even by our present microscopic methods, and it is possible that there is a congenital alteration, for the disease is often seen in young children."

The hemorrhagic nature of the change appears to be generally conceded, but a recent contribution of von Hippel† shows that in his case, examined two years after the onset, there were evidences of a true inflammatory exudative choroiditis from an unknown cause and none of the consequences of retinal and subretinal hemorrhage.

In the pathological examination in Case 1 we have found conditions for which the hemorrhagic explanation is quite satisfactory. In Case 2 the pathological findings rather point to an inflammatory process.

The bibliography is to be found quite complete in Coats's

* The observation of the development of the vascular changes in my case No. 4 is in accord with this view.

† Archiv f. Ophth., vol. lxxxvi, p. 442.

recent article.‡ I shall therefore append only the more recent literature not already referred to:

Cords: Netzhauterkrankung mit massiver Exsudation. *Zeitschr. f. Augenheilk.*, vol. xxvi, p. 514.
Frenkel: Kapillar-Angiomatose der Netzhaut. Anales d'oculist, März, 1912. Reviewed in *Klin. Monatsbl. f. Augenheilk.*, 1912, vol. l, p. 508.
Frank-Kamentzki, S.: Ein Fall von E. v. Hippelscher Krankheit. Westn. Ophthal., Bd. 29, S. 213, 1912. Reviewed in *Klin. Monatsbl. f. Augenheilk.*, 1912, vol. l, p. 508.
McMullen, W. H.: A Case of Retinal Disease with Massive Exudation. *Trans. Ophthal. Society United Kingdom*, vol. xxxii, p. 111.
Discussion on Retinal Vascular Disease; Pathological Aspects.
Coats: *Trans. Ophthal. Society United Kingdom*, vol. xxxiii, p. 30.
Bane: Angiomatosis of the Retina. *Ophth. Record*, xxii, 199.
Grimsdale: Exudation of Retina with Dilated Vessels. Proceed. *Royal Society of Medicine*, vol. vi, p. 92.
Hajano: Ein Beitrag zur Kenntnis der Retinitis exsudativa. *Archiv f. Ophthal.* vol. lxxxiv, 30.
Gilbert: Ueber juvenile Gefässerkrankungen des Auges. *Bericht. Ophthal. Gesellsschaft*, 39, Seite 47.
Stern: Ueber "Angiomatose" der Retina. *Centralblatt f. Augenheilk.*, Aug.–Sept., 1913, p. 298.
Vossius: Angiomatose der Retina. *Sammlung zwangloser Abhandlungen Augenheilk.*, ix, Bd. Heft 1.
von Hippel: Anatomischer Befund bei einem Falle von Retinitis exudativa. *Graefe's Archiv*, lxxxvi, Heft 3, Seite 443.
Harms: Seltene Hintergrundsbefunde bei Jugendlichen. *Graefe's Archiv*, lxxxvii, Bd. Heft 3.
Leber: Die Krankheiten der Netzhaut. *Graefe-Saemisch-Hess Handbuch der Gesamten Augenheilk.*, ii. Teil, vii Bd. Seite 30.

DISCUSSION

DR. WEEKS: I should like to ask whether therapeusis had had any influence on the cases.

DR. FRIEDENWALD: No effect was seen with any form of therapeutics that was given—not the slightest. Dr. Wilder, Dr. Herbert Harlan, of Baltimore, and Dr. Theobald have seen these cases.

DR. W. H. WILDER, Chicago, Ill.: I saw one of the cases that Dr. Friedenwald has described, and I never had seen anything exactly like it before. It seems to me that if we encounter such cases we should be able to recognize them as of the variety he describes, and we would not, ordinarily, confuse them with glioma. Whether we should be able to differentiate them ophthalmoscopically from cases that

‡ Archiv f. Ophth., vol. lxxxi, p. 325.

subsequently develop into retinitis proliferans is questionable. In a case of the latter disease, which I have watched for eleven years and still have under observation, if one were looking at the eye today, he would think of a condition of the retina in which there is massive exudation. A question that I should like to ask is whether Dr. Friedenwald saw any of these cases at any time before the exudation developed, and, if so, whether there was any hemorrhage into the retina that might subsequently have become organized, and whether he thought that this would have any bearing on the etiology of the process. In the case that I remember seeing with him there were no signs of retinal hemorrhage.

DR. HERBERT HARLAN, Baltimore, Md.: In one case that Dr. Friedenwald refers to, I saw the patient once, probably two or three months ago. I have nothing to add to what Dr. Friedenwald has said regarding this case. He had made an unfavorable prognosis, and the family were trying to find some one to promise something more.

I recall being in the elder Dr. Knapp's office twenty years ago, and during a busy morning he worked for an hour or more over a man in whose eye he found a similar condition. I think that Dr. Knapp reported this case, although I did not see the publication. He took the greatest amount of interest in the man, as being a very unusual case, and I recall it as being similar to the cases reported by Dr. Friedenwald. Dr. Knapp was inclined, at that time, to think his case malignant.

DR. HARRY FRIEDENWALD, Baltimore: In answer to Dr. Wilder I would say that, although small hemorrhages were visible in these cases, there was never a very large hemorrhage excepting in the first case. I was not able to see any of the cases at their inception, but I could observe their gradual progress; and even during that progress there was never any hemorrhage coincident with an extension. It was curious how the disease progressed. The condition remains stationary for days, weeks, or months; and then, with a sudden diminution of the field, there is an extension of the exudation. Either an additional sector is taken up or a broad band is added; and then you cannot see any line of demarcation between the new and the old.

THE CONVERGENCE INDEX AS A MEASURE OF THE CONVERGING POWER.

BY ALEXANDER DUANE, M.D.,

New York City.

Two methods of determining the converging power are in general use. One consists in determining the ability to overcome prisms, base out, thus measuring what is usually called the adduction, but is more properly termed the prism-convergence; the other consists in determining the convergence near-point.*

The prism convergence furnishes at best only an approximate indication of the real converging power. As is well known, the ability to overcome prisms, base out, varies extremely, the variations evidently not representing real differences in converging power but differences simply in knack, *i. e.*, aptitude in learning to perform an unaccustomed act. So we find some who at the start can overcome but 12Δ or 15Δ prism, base out, and who only after repeated trials can do more, and we find others who pass at once from these lower to the higher degrees. Yet, as other tests show, the two have equal and evidently normal converging power. It is only when the patient, after repeated trials, cannot overcome more than a certain comparatively weak prism, and particularly when, even if he does pass from one number to the next higher, he can maintain fusion with the latter but momentarily, that we can predicate from this test a low converging power. In such cases alone the prism convergence really becomes of value as a measure of the convergence,

*The converging power may also be determined with the amblyoscope or stereoscope, but these tests are not in common use for this purpose.

since it then really indicates the maximum of converging power then attainable. In the other cases it indicates much less than the true maximum.

Moreover, when strong prisms are used for measuring the convergence, the measurement is made uncertain by the fact that slight variations in the position of the prisms

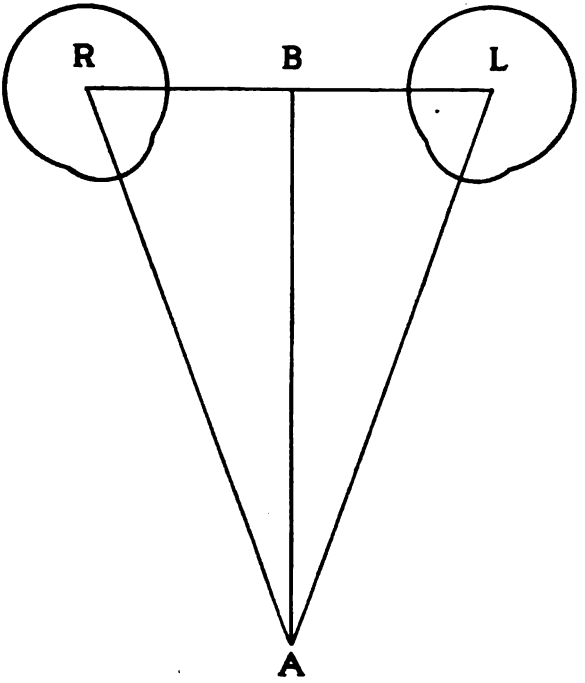


Fig. 1.—The Convergence Index.

A being the convergence near point, and R L the base line connecting the centres of rotation of the two eyes, the convergence index $=\frac{RB}{AB}\times 100$.

cause quite an appreciable change in their deflecting power, so that errors of 5° or 6° in the actual degree of convergence may thus be caused.

The determination of the convergence near-point (Pc) remains as our most reliable means of determining the actual converging power. It is often measured from the cornea, but should properly be measured from the baseline con-

necting the centers of rotation of the two eyes. We should be careful in any case to indicate from what point the measurement is made. We may conveniently use the symbol PcC if the measurement is from the cornea and PcB if it is made from the baseline. In Fig. 1, AB denotes PcB. This distance (PcB) can be quite precisely measured as follows: The patient's correcting glass, or in lieu of these a trial frame or spectacle frame placed on the patient's nose, is used as a reference plane, which is adjusted so as to be just 11.5 mm.* in front of the corneal apex when the eyes are directed straight ahead. The apex of a millimeter rule is placed against the point where the reference plane crosses the nose, and the rule itself is held perpendicular to the plane, so as to lie strictly in the midline. Along this the test object, which may consist of a pin, with white head two mm. in diameter, or a minute dot on a card, is carried straight toward the patient's nose, the patient all the time being exhorted to converge on it as sharply as he can. The moment the object doubles insuperably, or the moment one of the patient's eyes is seen to diverge, the distance of the object from the reference plane is measured. This distance plus 25 mm. will equal the distance (PcB) of the convergence near-point from the intercentral baseline.

When the patient has considerable vertical deviation, his converging power tested in this way may appear to be poor, when really it is quite good. For, when the test object is brought toward the eyes, he sees two images which he cannot bring together because they are on different levels. As he cannot unite them he makes no attempt to converge. In that case the dot used as the test object should be replaced by a vertical line. The patient will converge on this, because when he does so the two images will unite, even if on different levels, since the bottom of one will join with the top of the other. On such an object a patient will

*10.5 mm. if the eye is quite myopic; 12.5 mm. if the eye is highly hyperopic.

be able to converge sharply, even when for the dot he had apparently very little converging power.

This *convergence distance* (PcB) may be used itself as an approximate measure of the converging power. As such it may be indicated either in millimeters or in meter angles. In the latter case $MA = \frac{1000}{PcB}$ where MA is the number of meter angles and PcB is given in millimeters. But the convergence varies not only with the convergence distance (PcB) but also with the interpupillary distance (Pd), for the greater the latter the greater obviously the work the patient has to do in converging.

In fact, the true measure of the converging power is given by the fraction $\frac{R\,B}{A\,B} = \frac{\frac{1}{2}Pd}{PcB}$. This equals evidently the tangent of half the angle of convergence, RAL = C. I propose for this ratio, or rather this ratio multiplied by 100, the name *convergence index* (Ci). We have therefore:

$$Ci = \frac{\frac{1}{2}\text{ interpupillary distance} \times 100}{PcB}$$

A large number of measurements show that the convergence index usually ranges from 35 to 50. If it falls below 35 the patient has a low converging power, and if it persistently falls below 30 he has an actual convergence insufficiency. In many cases it reaches 55, and at times 60. The highest value that I have met with is 63. Now computation shows that the following rather remarkable and very convenient relation between the convergence index and the actual convergence in degrees of arc, in other words between Ci and C, obtains:

Ci	C
5 to 6	Ci + 1°
7 to 13	Ci + 2°
14 to 58	Ci + 3°
59 to 63	Ci + 2°
64 to 68	Ci + 1°
69 to 71	Ci
72 to 74	Ci − 1°

As an index of 14 means a convergence near-point distant 21 to 22 cm. (8 or 9 inches), and as an index above 58 is rarely met with, we say:

For all values of the converging power ordinarily met with, both in normal and abnormal cases, the actual converging power in degrees equals the convergence index plus 3°.

A simple case will illustrate the application of this rule. In a given patient we find a Pd of 60 mm. and the PcB is 75 mm.

$$Ci = \frac{30 \times 100}{75} = 40$$

Hence the actual degree of convergence (C) is 43°.

Even for higher or lower degrees of converging power the error in applying the rule is practically negligible. Thus, if a patient has a Pd of 62 mm. and a PcB of 300 mm. (about a foot)—an extreme case—the angle C reckoned by the rule would be 13°, whereas its true value is 12°; or a discrepancy of but one degree. So, too, if the patient with a Pd of 60 mm. converged down to a point 45 mm. from the base line—also an extreme case—the value of C reckoned by the rule would be 69°, whereas the true value would be 67°. With a convergence so extraordinary, a difference of 2° is of no importance. But in the rare cases where Ci is above 60, it is best to use the table above given.

The rule above given is also obviously useful when we wish to determine the actual angle of convergence made by the visual lines when the patient is regarding an object at any rather near point whether this is his actual near point of convergence or not. When he is so converging, the angle of convergence C^1 is to all intents and purposes given by the relation:

$$C^1 = \frac{\frac{1}{2} \text{ interpupillary distance} \times 100}{D} + 3°$$

where D = distance (from the intercentral baseline) of the object in millimeters.

We may make the statement perfectly general and also perfectly accurate by putting it as follows:

If an object is at a distance D from the intercentral base line, and we denote by Ci′ the fraction

$$\frac{\text{½ interpupillary distance} \times 100}{D}$$

and by C′ the angle of convergence of the visual lines, then

C′ = Ci′ + 3° if D is between 5 and 22 cm.
C′ = Ci′ + 2° if D is between 22 and 50 cm.
C′ = Ci′ + 1° if D is between 50 and 100 cm.
C′ = Ci′ + 1° if D is between 50 and 100 cm.
C′ = Ci′ if D is over 100 cm.

Ci′ in this case may be called the *relative* convergence index, inasmuch as it corresponds to a point upon which the eyes are converged when not using their maximum converging power.. When the eyes are converging to the maximum, so that D represents the distance (PcB) of the real near point of convergence, the convergence index may be called *absolute.*

Since the convergence index by the simple relation indicated gives us the converging angle, it may be said to measure quite directly the *power* of convergence. It has been objected, however, that after all what we wish to know is, not so much the power as the *availability* of convergence. In other words, we wish to know, not how great the angle C is, but how close the near point A is. The closeness of the latter, in fact, measures the usefulness of the converging power for the patient, just as the closeness of the near point of accommodation measures the usefulness of the accommodation in enabling the patient to read. But there is a considerable difference between the two cases. Two persons with the same range of accommodation may have near points differing widely, insomuch that one of the two can read with the utmost ease and the other cannot read at all. But if

one person has the same convergence index as another he cannot have an essentially different convergence near point. In fact, for any ordinary value of the index, the variations in the position of the convergence near point cannot possibly amount to more than 2 cm.,* and are usually much less, so long as the index remains the same. Even when the index is low, and the near point of convergence consequently remote, the discrepancies in the position of the latter, although now somewhat greater, are still relatively small and in no case so great as to be of practical importance.

We may say, therefore, that the convergence index is not only a true measure of the converging power, but gives also in all cases a sufficiently accurate notion of the utility of this converging power for the patient—i.e., of its availability in enabling him to look at near objects.

DISCUSSION.

DR. ALEXANDER DUANE, New York: It is hardly worth while to refer to it in an assembly like this where every one knows how to record these things; but I was surprised to find how many oculists are unaware of the true method of measuring the pupillary distance in order to get it right to within a millimeter. This can be done while making the measurement I have described. Direct the patient to cover the left eye and to look with his right into your left. Cover your right eye and sighting with your uncovered left, place the zero of a millimeter scale opposite the center of his right pupil. Then, holding the scale steady, make him open his left eye and cover his right, while you open your right eye and close your left. Sighting with your uncovered right eye you now note what point on the scale is opposite the center of the patient's left pupil. This will give the pupillary distance when the eyes are parallel, and this too whether the patient has a deviation of the eyes or not.

* Thus with a convergence index of 30 (quite the lower limit of normal converging power), the distance of the convergence near point, *i. e.* the PcB, would be 9 cm. if the interpupillary distance was 54 mm. and 11 cm. if the interpupillary distance was 66 cm.

DR. LANCASTER: Will Dr. Duane tell us also how he measures the distance from the cornea to the lens in the trial-frame?

DR. DUANE: I would say that I take this measurement simply by making the patient look straight ahead, while I look at him from the side and read off from a millimeter scale placed against the temple the distance between his cornea and the reference plane. That, of course, is a little rough; and a simple instrument could be devised to enable one to do it with precision. It is, however, accurate enough.

DR. ROBERT S. LAMB, Washington, D. C.: With regard to getting pupillary distance, I would say that I have used a two millimeter pin-hole disk for years. In the trial-frame, or optometer, one pin-hole disk is placed over each eye, and each in turn is covered with a blank disk until the patient can see with each eye the same test object at twenty feet. Later I take the pupillary distance for near work in the same manner, using No. 1 of Jaeger test type.

I find the difference between the pupillary distance for distant vision and near vision sometimes as much as five millimeters. I take the pupillary distance on all patients in that way. The procedure is very useful, and for accuracy in obtaining pupillary distance I have found nothing to equal it.

CURVATURE AND INDEX MYOPIA, WITH REPORT OF CASES.

A. EDWARD DAVIS, M.D.,

New York City.

Curvature Myopia.—This condition may be due either to an excessive curvature of the cornea or of either surface of the crystalline lens. In a normal eye, curvature myopia rarely exceeds in amount more than one or two diopters, in fact, seldom reaches that amount. When of considerable or large amount it is always associated with pathologic

conditions, as conical cornea or conical lens, and in such conditions there is also an irregular astigmatism to deal with. As cases of conical cornea are not so uncommon, that condition may be passed over in this brief paper. Cases of posterior lenticonus are comparatively common also, while anterior lenticonus is extremely rare, less than a dozen cases being reported in all literature. One such case, in which both eyes were affected, I have reported in my book on the Refraction of the Eye. On account of the exceeding rareness of such cases, I venture to give a brief resumé of it here.

Case 1.—J. L. H., aged fifty-seven, a lawyer, in good health, consulted me because of a severe migraine. At the time he consulted me he was wearing for reading, R.E., +2.50 cyl. ax. 180° ⌓ −3. cyl. ax. 90°; L.E., +2.50 cyl. ax. 180° ⌓ −1.50 cyl. ax. 90°.

The ophthalmometer showed a regular astigmatism *with the rule* of 2 D. in each eye. The patient accepted for the distance: V.R.E., $\frac{20}{200}$ −5 sph. ⌓ −2.50 cyl. ax. 90°. = $\frac{20}{50}$; L.E., $\frac{20}{200}$ −1 sph. ⌓ −3. cyl. ax. 75° = $\frac{20}{30}$. For reading: R.E., −1. sph. ⌓ −2.50 cyl. ax. 90°; L.E., +3. cyl. ax. 165°.

These glasses gave entire comfort. In this case, because of the great discrepancy between the astigmatism as indicated by the instrument and that found on subjective examination, I immediately suspected some trouble with the lens—an incipient cataract, perhaps. On examination with the ophthalmoscope I found no opacity of the lens whatever, but to my surprise a transparent protuberance of a conical shape on the front surface of the lens of each eye. The corneæ were perfectly clear, except for a very minute opacity just at the outer side of the center of the left. The shadows reflected from the pupil resembled in a marked degree the shadow crescents seen in conical cornea. I could not get a double image of the fundus by the direct method with the ophthalmoscope, as did Webster in his case, the first of this kind reported; however, I did not have the pupil dilated as he did, and besides, the conicity was not so marked in my case as in his, so far as I can judge by read-

ing the account of his case and looking at the excellent diagrams he gave.* With the indirect method, however, I got a decided diplopia of the retinal blood-vessels, both vertical and horizontal; also the parallactic movement by which the double images could be made to approach toward or recede from each other by the slightest movement of the ophthalmoscope or object lens. The fundus was normal in each eye.

According to my own tests when he came to me, he must have had a lenticular astigmatism against the rule of 4.50 D. right and 5 D. left in order to have a total astigmatism against the rule of 2.5 D. right and 3 D. left, because he had 2 D. of corneal astigmatism *with the rule* in each eye.

Case 2.—The following case, in my opinion, is one of curvature myopia, though not susceptible of undoubted demonstration. Mr. L. C., aged forty-seven, sent to me January 2, 1914, with history of several attacks of iritis in the last eleven years, affecting first one eye then the other. Gives a doubtful specific history; has had mixed treatment off and on, also tuberculin treatment.

Present Condition.—Javal-astigmatism with rule 1.50 D. 90+180− in each eye; horizontal equaled 44 D. and vertical equaled 45.50 D. each. V. R. E., $\frac{20}{20}-1$. cyl. ax. $180°=\frac{20}{20}$; L.E., $\frac{20}{50}-1$. cyl. ax. $180°=\frac{20}{50}$.

In right eye there is a mild iritis with complete posterior synechia, except a space of about 1 mm. directly above which is free, atropine failing to dilate pupil; fundus normal. Left eye shows signs of the previous attacks of iritis, operative coloboma above, and posterior synechia binding down remainder of iris. Tension normal each eye, right 15, left 22, by tonometer.

The patient was placed on local treatment of atropin and hot fomentations, and his family physician gave him mixed treatment of mercury inunctions and increasing doses of K. I. In the meantime I gave him diagnostic tuberculin injections, but these were negative. At the end of ten days, January 10, the iritis had grown worse and his vision was reduced to $\frac{20}{100}+$, increased to $\frac{20}{40}$ with -1 sph. $\bigcirc-1$. cyl. ax. 180°.

*1. *Archiv. Ophthalmol. and Otol.*, 1874-1875, vol. iv, p. 482.

January 29. The iritis was greatly improved, no pain, and the eye only a little red, but the vision was reduced to $\frac{20}{200}$; with -3 sph. $\bigcirc -1$. cyl. ax. 180°, this was brought up to $\frac{20}{20}+$. One per cent. atropin had been used in this eye three times a day, all the while.

March 13, 1914, two and a half months after the patient came under treatment, V. R. E. $=\frac{20}{20}-$, with -1 cyl. ax. 180° $=\frac{20}{20}+$.

The eye was entirely quiet. The patient saw almost as well without the glass, only he squinted the lids, as with it when he left the eyes wide open. The ophthalmometer showed no change in the curvature of the cornea when the myopia was at its greatest amount, 3 D., than at the beginning and at the close of the treatment, running uniformly at 44 D. in the horizontal meridian, and 45.50 D. in the vertical. Because of the narrow pupil the examination of the lens curvatures with the Souter ophthalmophakometer was not very satisfactory, though the posterior surface indicated about .50 D. astigmatism against the rule.

I am unable to account for the myopia in this case, unless it be due to the increase in the curvature of the lens surfaces, or to increase of the index of refraction of the lens. It certainly was not due to an increase in the refractive index of the aqueous, as this remained clear, and there was no sign of diabetes at any time, which might give rise to such a condition of increase of index of refraction.

The possibility of the traction of the iris on the lens capsule (there being present an almost complete posterior annular synechia) when the iris was acted upon by the atropin has suggested itself to me. By pulling the capsule slightly forward, this would allow the lens to expand and increase the curvature of the anterior surface. Or this increased curvature of the lens could be explained by ciliary spasm, due to the irritation from the inflammatory process, which was not relieved by the use of the atropin until the inflammation had subsided.

Hess, cited by Parsons,* has reported a myopia of 5 D. which developed in an eye during iridocyclitis.

Index Myopia.—This may be caused by an increase in the refractive index of the cornea, aqueous, or the lens, or to a decrease in the refractive index of the vitreous. Well-authenticated cases of any considerable amount of myopia due to an increase in the refractive index of the aqueous humor have not been reported. Parsons states that to produce myopia of 1.50 D. to 2 D. would require that the aqueous have an index equal to that of the cornea.

"The myopia of diabetes cannot be explained by increase in the aqueous index. The aqueous would have to contain 20 per cent. of sugar in order that its refractive index be raised to that of the cornea, a result which would only cause a myopia of 1.50 in a previously emmetropic eye."

Moreover, a concentration of even 5 per cent. of sugar, according to Deutschmann, would cause opacity of the lens.

Again, cases of myopia due to decrease in the refractive index of the vitreous humor have not been reported, though Landolt† has reported *hyperopia* in a diabetic as due to an *increase* in the refractive index of the vitreous. The most common form of index myopia is that occurring in old people due to an increase in the refractive index of the crystalline lens, especially in the nucleus of the lens. This change in the refractive index of the lens in the aged, together with a slight swelling, is accountable for the cases of so-called second sight.

This index myopia of the lens in the aged, however, as is well known, is usually followed in a short time by formation of a cataract, so that second sight, as a rule, ends in no sight at all. There are a few rare exceptions to this rule, where the second sight is retained for years.

This myopia in the aged, as the result of the increase in

*The Pathology of the Eye, vol. iii, p. 929.

†The Refraction and Accommodation of the Eye, p. 419.

the refractive index of the lens, may be of rather large amount, Landesberg having reported as high as 10 D., Fuchs 9 D., Herrnheiser 7 D., Weeks 6 D., while many other cases of lesser amount have been recorded.

The following case of 2.50 D. of myopia in a patient, aged seventy-five, is of added interest because a beginning opacity in one lens cleared up in the six years the patient was under observation.

Case 3.—April 25, 1908, M. G. H., aged sixty-nine; in good health. Javal equaled astigmatism with the rule, .50 D. axis 90−180 each eye. V. R. E., $\frac{20}{100}-$ +1.50 sph. $=\frac{20}{15}$; L. E., $\frac{20}{100}-$ +1.12 sph. ⊂ +.37 cyl. ax. 180° $=\frac{20}{15}$. Jaeger No. 1, eight to twenty inches, with +3.50 sph. added. Ophthalmoscope shows incipient cataract in the right eye, one spicula in the inferior nasal quadrant. Left eye normal. Lenses were ordered for distant and near.

February 3, 1914, six years later, the patient returned complaining that she sees better in the distance without any glasses, and says she uses the distance glasses now to read with. The ophthalmometer gives same reading as at first test: V. R. E., $\frac{20}{30}$ −1. sph. $=\frac{20}{15}-$; L. E., $\frac{20}{30}$ −1. sph. $=\frac{20}{15}-$. Reads Jaeger No. 1, eight to twenty inches, with +2.50 sph. The opacity in the right lens has disappeared. The patient is in good health. Ordered +2.50 sph. for reading. No distance glasses.

Case 4.—*Index Myopia from Diabetes.*—Mrs. S. B., aged forty-two, consulted me first June 15, 1907, because of headaches when she read. Javal showed astigmatism .50 D. with the rule in each eye. V. R. E., $\frac{20}{20}-$ +.25 cyl. ax. 70° $=\frac{20}{15}$; L. E., $\frac{0}{20}-$ +.50 cyl. ax. 110° $=\frac{20}{15}$.

Jaeger No. 1, eight to eighteen inches, with +.75 sph. added. Normal fundi. Ordered reading glasses.

December 2, 1908, about eighteen months later, patient returned because her vision was poor for distance. Corneal astigmatism the same as at previous test. V. R. E., $\frac{20}{100}$ −1.25 sph. ⊂ −.25 cyl. ax. 160° $=\frac{20}{20}-$; L. E., $\frac{20}{70}$ −1.

sph.⊂ −.50 cyl. ax. 20° = $\frac{20}{20}$ −. Fields normal. Ophthalmoscope shows normal fundi. No lens opacities.

Because of this change to myopic refraction diabetes was suspected, and an examination of the urine showed a large amount of sugar, 7.7 per cent. by polariscope, and strong reactions to Fehling's and Nylander's tests. Specific gravity 1037.

The patient was placed on a strict non-sugar diet, also given small doses of arsenic, and has been kept under frequent observation for the last seven years. Two months after the sugar appeared in the urine there were faint striæ of opacities at the periphery of the right lens in the superior temporal quadrant, but these have not advanced.

At present V. R. E., = $\frac{20}{15}$ with −1.25 sph.; L. E. = $\frac{20}{15}$ with −1 sph. The highest myopic refraction reached was R. E., −2.25 sph.⊂ −.25 cyl. ax. 160°; L. E., −1.50 sph.⊂ −.25 cyl. ax. 20.°. At each exacerbation of sugar the patient had small round hemorrhages, from one or two to six or eight, appearing in the retina. These have always been absorbed without injury to the vision. The patient is in good health but must keep on the diet. She also takes the arsenical preparation. Tension of eyes is normal, 15, by the tonometer.

Case 5.—*Index Myopia from Diabetes.*—September 11, 1913, Mr. H. H., aged forty-two, six days previous to consulting me noticed that his vision became rather suddenly blurred for the distance and has continued to grow a little worse since. Until now his vision has been good. V. R. E., $\frac{20}{200}$ −1.50 sph.⊂ −.50 cyl. ax. 165°. = $\frac{20}{30}$ −. L. E., $\frac{20}{200}$ + −1.50 sph.⊂ −.50 cyl. ax. 15°. = $\frac{20}{20}$ −.

Ophthalmoscope shows rather pale optic discs, especially on temporal half. No retinal hemorrhages. Examination of urine shows large amount of sugar, 9.99 per cent. by polariscope. Fields normal. Tension normal. This patient was seen the second time two days later, and was somewhat improved in sight; under strict diet. He has not been seen by me since; therefore I do not know the progress in his case.

DISCUSSION.

DR. E. C. ELLETT, Memphis, Tenn: I should like to report a rather interesting case of index myopia that I saw four years ago in a child seventeen months old, who was suffering with quinine amblyopia. The refraction in this case equaled, at one time, 8 D. of myopia in the right eye and 12 D. in the left, as measured with the ophthalmoscope. With the clearing up of the condition and the restoration of vision, which occurred in six or eight weeks, refraction returned to about emmetropia. I have recently seen a second case which reminds me of that one. It is still under observation, and is, as nearly as I can determine, blindness due to a toxic amblyopia of some sort in a child convalescing from typhoid fever. There is low myopia, about 3 D. or 4 D., but I am unable to say what the condition was before blindness came on, or what the refractive condition will be when it disappears, as it is doing very rapidly.

DR. EDWARD STIEREN, Pittsburgh, Pa.: I desire to report my observations in two cases of keratoconus in which there was an atrophic condition of the pituitary body. The first patient, whose eyes I examined for Dr. Samuel Ayres, had had a radiogram made of her skull which showed an unusually small sella, with overlapping of the clinoid processes. This patient possessed a high degree of conical cornea in each eye. The second case is that of a nurse who has a moderate conical cornea of one eye and a high degree of keratoconus in the other. A radiogram of her skull shows an abnormally small sella. This patient has also an enlarged thyroid gland.

Whether there is any significance in this is problematical. An interesting thought in this connection is the beneficial results that follow the internal administration of preparations of the ductless glands, especially the thyroid, in affections of the cornea, and the intimate relationship of the internal secretions from all these glands in regulating the nutrition of the body. It seems probable that in conditions of hypopituitarism that the nutrition of the substance of the cornea could be so affected as to result in relaxation and the formation of keratoconus. It is my intention to have

the skulls radiographed in every case of conical cornea and to note if this condition is consistent.

DR. SAMUEL THEOBALD, Baltimore, Md.: In Dr. Davis's cases, where he spoke of a marked increase in myopia, it occurs to me to ask whether the anterior chamber was shallow. If the crystalline lens had come forward, the increase in the myopia might be explained. I am inclined to question the correctness of Dr. Davis' view that the myopia which not infrequently develops during the early stage of cataract is an *index* myopia. It seems to me much more probable that the change in refraction is due to a swelling and consequent increase in the convexity of the lens, rather than to a change in its refractive index.

DR. A. EDWARD DAVIS, New York: I have nothing further to say except to touch on the point that Dr. Theobald speaks of. I believe, myself, that many of these cases are due in part to swelling of the lens; but I consider the major part to be due to the increase of the index of refraction of the nucleus.

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